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Popular Science

MONTHLY

How to Get Your Car Engine Tuned Right

BLUEPRINT for a Saw That Speeds Your Plywood Projects

MARIO ANDRETTI
Test-Drives
the New Mustang

The Truth About
Breaking In a New Car

Buyer's Guide to
Personal Tape Recorders

MOTORCYCLES:
What I
Like in
a Bike
and How
I Pick 'Em
By STEVE McQUEEN

Now! A Drug That May
Make You Smarter

IN COLOR:
How to Stain
Wood

STEVE McQUEEN on the bike he built for himself

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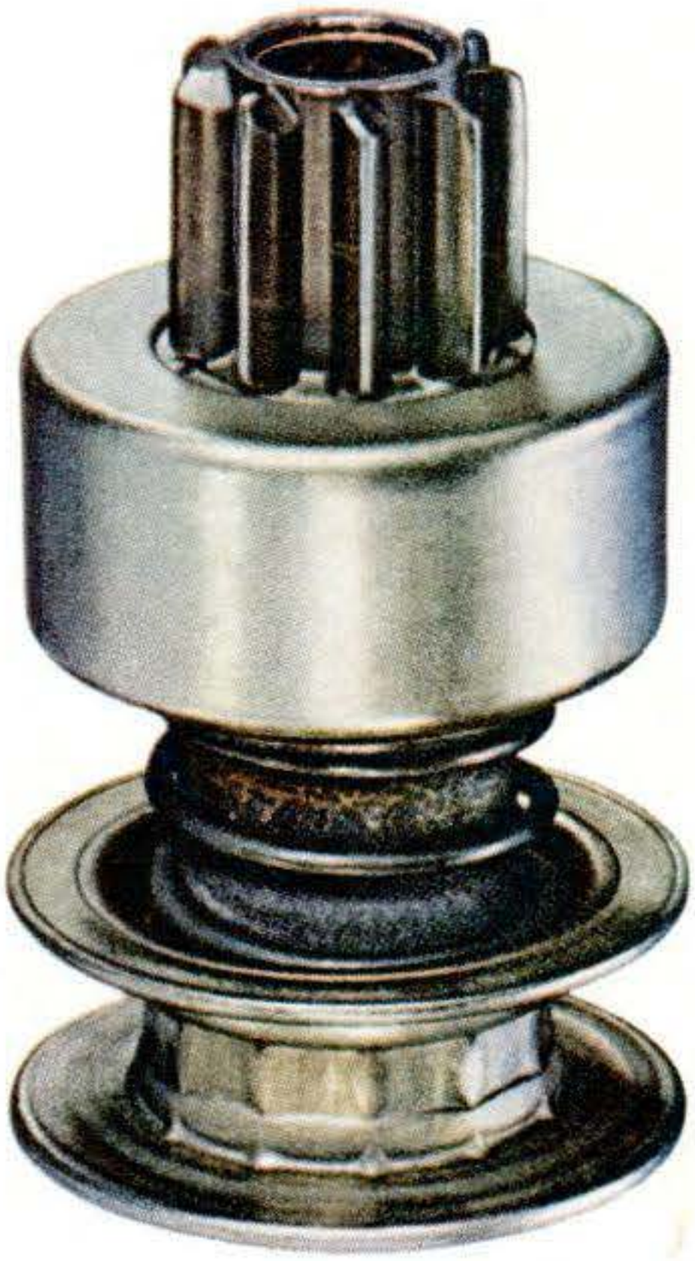
This is a GM Original:
It's as tough as they come.



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Motorcycles: What I Like in a Bike BY STEVE McQUEEN PAGE 76
The wheels-wise movie star gives the lowdown on cycles—and tells how he built his own.

Can This Drug Make You Smarter? PAGE 82
The inside story of a remarkable drug, Cylert, now being tested.

Mustang: They've Improved the Breed BY MARIO ANDRETTI PAGE 86
How does the new Mustang stack up? America's leading race driver gives the straight-from-the-shoulder answer.

The Saw That Speeds Your Plywood Projects PAGE 150
Want to make accurate cuts on big plywood panels? You can, with this traveling, up-side-down panel saw that you build yourself. Lie-flat blueprint shows all details.

How to Use Stains to Get the Color You Want PAGE 170
Simple materials and easy techniques help you bring out the beauty of wood—more on "Best Finishes for Wood."

COVER PHOTO BY CHAN BUSH

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COMING NEXT MONTH

ANDRETTI TESTS THE BARRACUDA

Famous race-car driver Mario Andretti puts the '67 Barracuda through its paces to give you a driver's-seat report. Also for car lovers: Test Report on Ford, Chevy, Plymouth . . . Why Your Car Stalls . . . Tires: What You Should Know.

And there's lots more:

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Mechanics and Handicraft ® Popular Science ®

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PRINTED IN U.S.A. 24

Carburetor gum can choke the life out of your engine

Remove it easily with GUMOUT

THE gasoline constantly being evaporated in your carburetor leaves a residue of varnish and gum. As this builds up, your carburetor has trouble "breathing." The symptoms are hard starting, stalling, rough idling, power loss, poor gas mileage.

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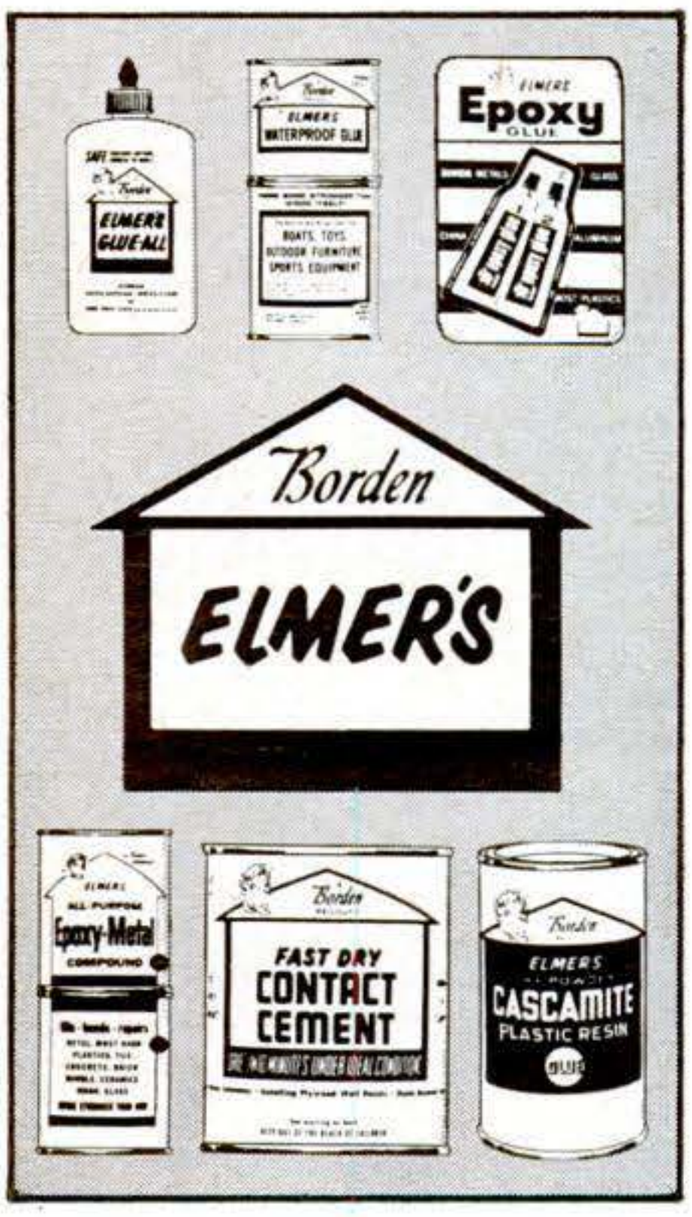
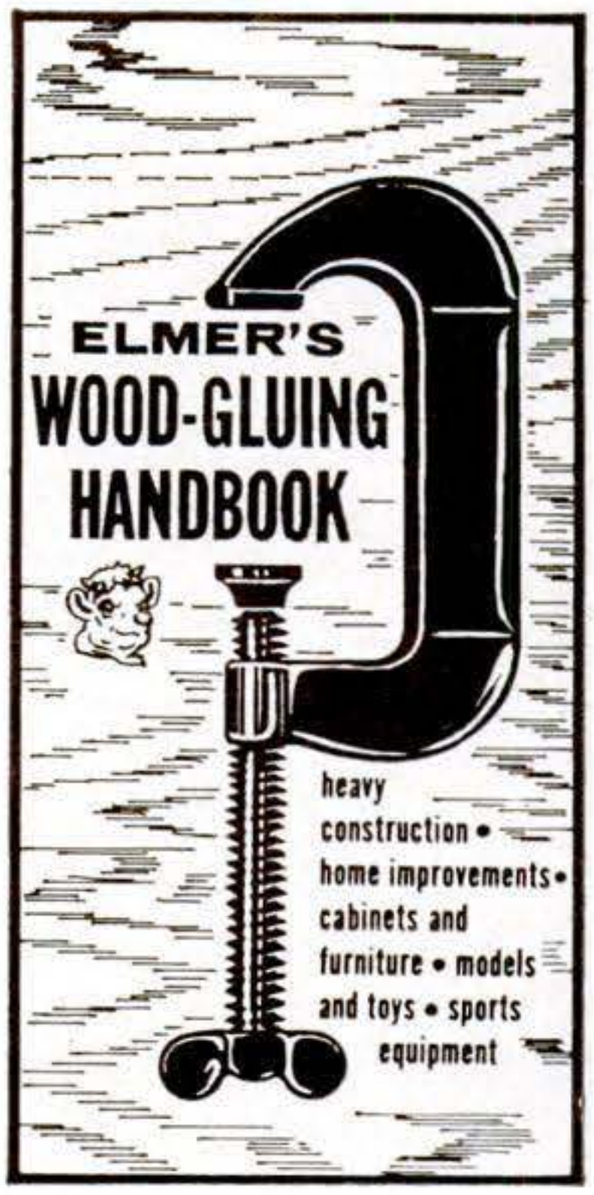
How to pick the right glue to do the job right!



1. Look for the name—ELMER'S

2. Send for this FREE BOOKLET

It tells you how to match the right glue to the type of job and the kind of material...so that you get a perfect bond every time. It gives you scores of tips to make gluing faster and easier. It's yours if you'll just send a stamped, self-addressed envelope to: The Borden Chemical Company, Dept. S-1, 350 Madison Avenue, New York, N.Y. 10017.



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It has started a million people on the road to success. Just looking at it won't get you anything... but putting it in the mail can change your whole future!

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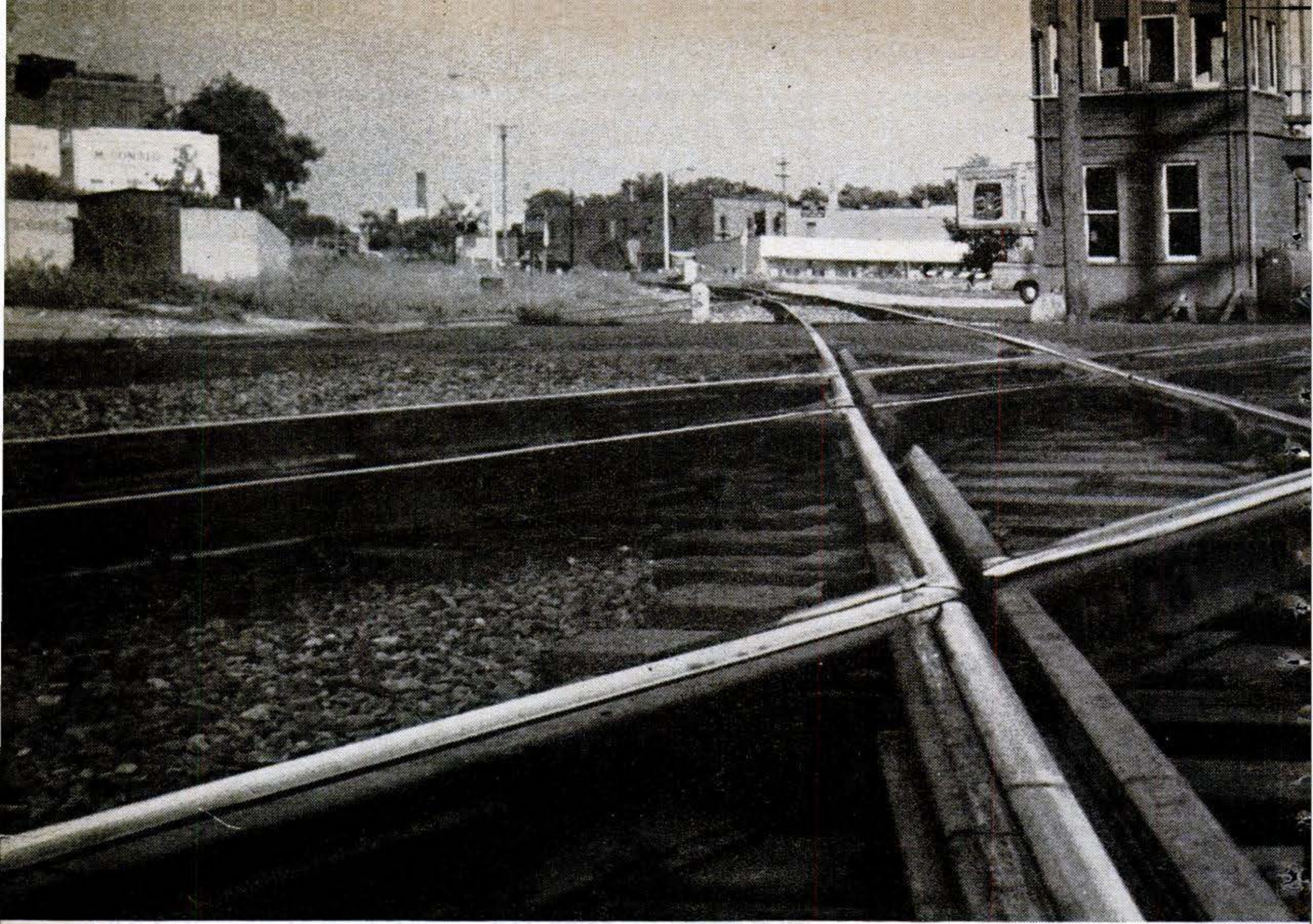

Some vans sway and bounce across tracks because they have a very short wheelbase. GMC's new Handi-Van is different. It has a longer 108″ wheelbase. We didn't give in to the temptation of tacking on more metal back of the rear axle. We didn't try to fool you by stretching out the body to give you more loading area. We refused to give you the excessive rear overhang and exposed seams you find on some makes. Instead, GMC's Handi-Van gives you a tremendously stable ride. (You'll feel the big

If you think all vans are our new one over some

GM

MARK OF EXCELLENCE

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difference the first time you load up.) V-8 power is available. Safety equipment includes a padded dash, pushbutton seat belts and more. You'll have to go some to better our features. And you'd probably expect to dig a lot deeper into the budget to get a truck that could even equal GMC features. Yet the prices of all vans are pretty close. If you still think vans are pretty much alike, there is only one thing to do. Go see your GMC Truck dealer. What a difference he can make on your whole attitude toward trucks.

pretty much alike, run railroad tracks.

The Truck and Coach Division of General Motors

GMC

What a difference a name makes

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PS Readers Talk Back

Want to get something off your chest? Write "Readers Talk Back," POPULAR SCIENCE, 355 Lexington Ave., New York, N.Y. 10017.

Trucks—a highway hazard?

All the talk on safety has ignored one of the greatest highway hazards—big trailer trucks. The single trailer is bad enough, but now tractors are allowed to pull two and even three trailers, multiplying the danger. Trucks whip you around when they pass, or blind you with spray on a rainy day when you follow behind, and throw gravel at your windshield that's as dangerous as a bullet. Most truck drivers pay little attention to highway signs and safety. Maybe it's the fault of the companies who set schedules that make drivers throw caution to the wind, even if it kills someone. I would like to see laws that cut down on truck length, width, and loads. I would also like to see trucks restricted to certain roads.

GEORGE ELDERSTROM, Kansas City, Kan.

Trade-in for Gus?

I admire Gus Wilson's brilliant trouble-shooting, but his tow truck bugs me. Isn't it about time he traded that 18-year-old Ford relic for a late-model hauler?

A1C GEORGE LEMON
Wright-Patterson AFB, Ohio.

Gus is loyal to old friends.

Good base for marble-chip project

"Bring Glamor to Your Yard with Marble Chips" [Aug.] by Alex Markovich was interesting, but I have an idea which would make the

project nearly permanent and weedproof. After you finish excavating, and complete the installation of all necessary forms, place a layer of black polyethylene film in the excavation carefully so as not to tear it. Then place the marble chips or other mulch over it and the job is complete. The polyethylene keeps weeds from sprouting and prevents a noble project from turning into an unsightly mess.

SYDNEY G. ROSENBLATT, Havertown, Pa.

Eliminate the unnecessary

'Tain't necessary to force a hose connector on a ¾-inch pipe fitting as you show in "Wordless Workshop" [Aug.]. Hose connectors—male and female—with standard pipe threads on the opposite end are available as standard hardware items.

CLYDE ANKENBAUER, Cincinnati, Ohio.

Magic-box game is easy when you know how

Ronald M. Benrey's article "This Magic Box Plays a Game . . . Can You Beat It?" [Aug.] has me stumped. I have thought about it for hours without finding a solution. How about giving us the answer?

ERIC WOLLMAN, Brooklyn, N.Y.

Here's the solution: The farmer crosses the river seven times. He takes goose across, leaving fox and grain behind; returns to south shore; takes fox across to north shore; returns to south shore with goose; takes grain to north shore, leaving goose behind; returns to south shore, leaving fox and grain; takes goose to north shore.

Moving a dam site

In your picture story on the Exchequer Dam [Sept.] you say it is in Yosemite Park. Actually the dam is not in the park, but about 40 miles downstream.

DUANE L. CRONK, Angwin, Calif.

1932 Chevy owner hoists help-wanted sign

Help! I have a 1932 Chevrolet roadster and I have had a terrible time finding parts for it. Can anyone tell me where to go?

L. C. EDWARDS, Louisville, Ky.

Sinking an old belief

In "Low Cost Glass-Bubble Sub for Undersea Adventure" [July], you say that when the vessel's pontoons are flooded, the craft is neutrally buoyant and hovers. I was taught that, in practice, it is impossible to attain neutral buoyancy—that an object will either sink or float. Is this no longer true?

PHILIP A. HAAS, Evansville, Ind.

In practice, neutral buoyancy is possible. Navy submarines do it every day.

Wrong astronaut in a fog

In "Science Newsfront" [Sept.] you say that astronaut Frank Borman's faceplate fogged up

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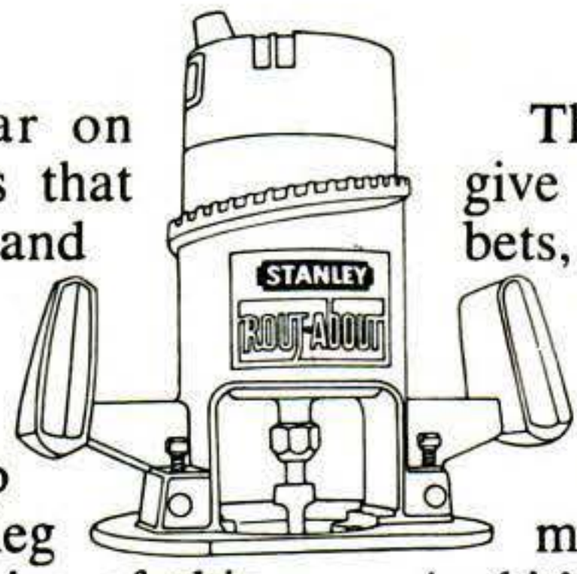
You don't have to spend a lot of money to join Stanley's war on cheap power tools.



We're waging war on cheap power tools that burn out, short out and vibrate till your teeth rattle.

But that doesn't mean you'll have to pay an arm and a leg to join us. The price of this Stanley Job/Master Rout-About is just $34.95.

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And it's made the same way we make our power drills, sanders, sabre and circular saws: with our own good motors and heavy-duty housings.

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MENNEN *SPEED STICK*®

PS Readers Talk Back

[*Continued*]

on the Gemini 9 mission. This is not true. Borman was in the Gemini 7 crew. It was Gene Cernan whose space walk was cut short because of a fogged visor.

BOB BARKER, Tucson, Ariz.

Right you are.

Delighted reader delights us

You've got a real great magazine. I've been reading it regularly for years and I think you deserve a word of thanks for all the work that must go into it to print some of the great articles in each issue. Keep up the good work for the best book going.

A2C JAMES PIERCE, Turner AFB, Ga.

Thanks. We will.

How deep is the ocean?

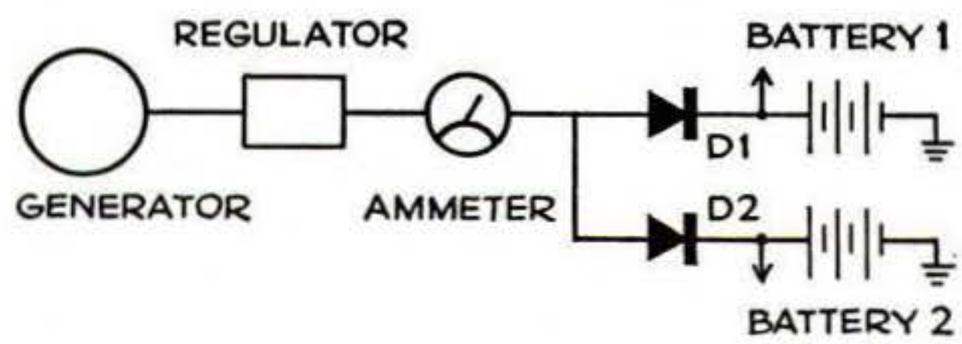
In "The Ocean Adventure" you say that the deepest known point in the ocean is 35,800 feet (5,967 fathoms). The British Admiralty made a sounding in the Philippines which was 37,782 feet deep (6,297 fathoms).

ALAR R. DIEDERICHSEN, San Diego, Calif.

At the time Piccard and Walsh made that dive, 35,800 was the deepest known ocean depth. Since then several deeper points have been located.

Spare solution to question about spare battery

I was interested in Smokey's solution to the problem of installing a spare battery in a Land Rover. Here's the way I put a spare battery in



mine. I placed a silicon diode in series with the charging circuit and each battery. I also set the voltage regulator slightly higher because of the 0.4-volt drop in the diodes. This will work only with D2, but battery 2 will always have slightly lower voltage, although it will reach a full charge after the first battery is charged all the way. One 80-amp Motorola-type MR 1213SL silicon rectifier is probably the best choice.

GEORGE W. HARVEY, Del Mar, Calif.

Setting us straight on dragsters

The article "8-Second Miracle Machines" [Sept.] was very mixed up. Here are just a few of the mistakes in the story. The 426-cu.-in. engine shown on page 76 is really a 425-cu.-in. Toronado engine. You say Dick Landy's

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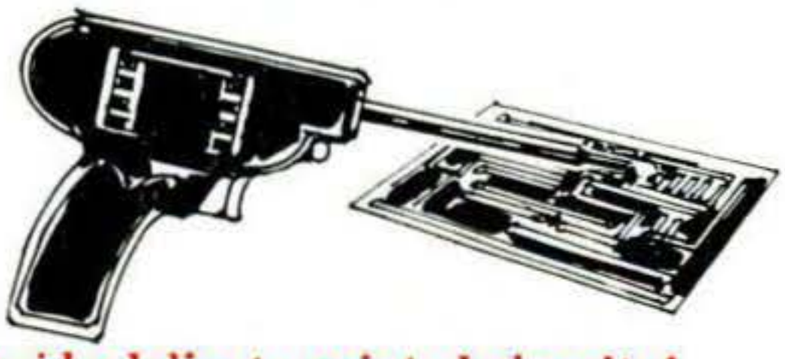
HERE'S PROOF!

Wen single post soldering guns go where no other guns or tools can!



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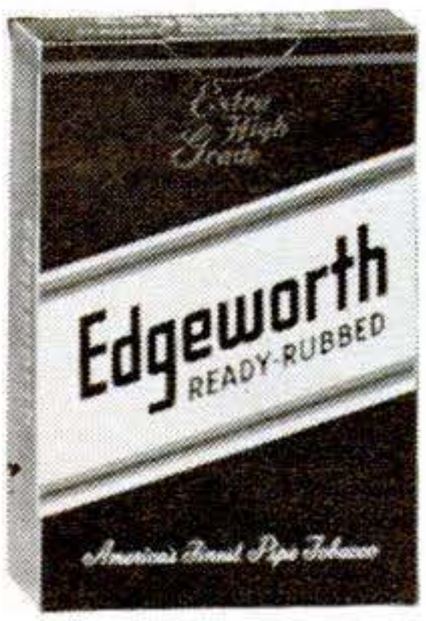

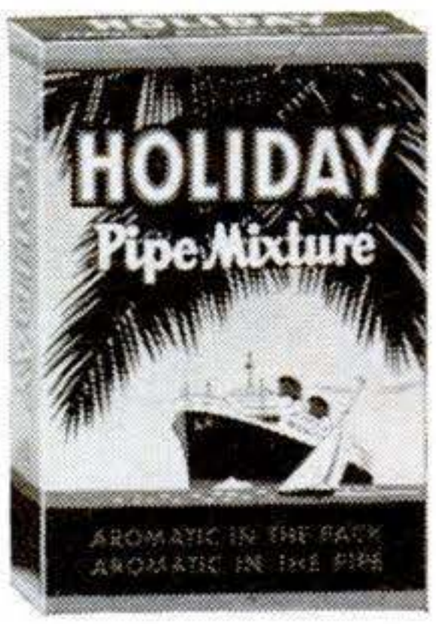

You'd expect to pay at least $1.50 for this smart pipe carved from richly grained imported briar, with carbonized bowl and genuine hard-rubber screw-in stem. It's yours free, for only six empty inner pouches from House of Edgeworth's best loved tobaccos. Edgeworth Ready-Rubbed, with its blend of choice, cool-smoking Burleys, or Holiday Mixture, with the famous aroma men relish and women welcome, too.

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PS Readers Talk Back

[*Continued*]

Dodge has cheater slicks. Dad, them ain't cheater slicks. They are regular dragster slicks. Cheater slicks have tread. Those are not headers coming through the hood, either—they are ram tubes for Hilborn injectors. The Chevy II engine you show was not originally 350 hp. It was a 425-hp. Sting Ray mill-bored to 427. It is pulling around 900 horses and not 800 as stated and it is not supercharged, but normally aspirated.

TOM MCKINNON, Iowa Park, Tex.

Which oil is best for your car

One question I hoped Jim Dunne would ask Ford's Ray Potter in "Which Oil Is Best for Your Engine" [Sept.] was about the hazard of mixing different brands of oil. Is there any risk of engine damage if you change brands without a complete flush-out?

W. K. MCCANDLESS, Walla Walla, Wash.

It is a good idea not to mix brands of oil in your crankcase even though the chances of serious incompatibility are pretty slim. The old oil left when you change oil is not serious enough to fret about.

Getting up steam on steam engines

Reader Ken Gardner's letter ["Readers Talk Back," July] commenting on my Elliptocline steam engine [Feb.] says that steam-generator or boiler design is the only problem in steam-automobile development, and the most rudimentary steam engine would propel a car. This is very misleading. True—such an engine would, but not acceptably by today's standards. For equal power, a rudimentary engine easily could require 20 times the steam needed by the most efficient modern steam engine. This would create a boiler problem, because the rudimentary engine would require a boiler 20 times as big as the modern engine needs (likewise, the condenser). By producing the most efficient engine possible, the boiler problem is eliminated.

THOMAS A. HOSICK, Winston-Salem, N.C.

Sterling engine experiment

After reading "Amazing No-Fuel Space Engine You Can Build," [July, '65], I built one—with a few modifications. I also ran some tests on the little engine, which worked beautifully. To measure its horsepower and efficiency, I used thermocouples and an old aircraft exhaust-temperature gauge while using the motor to lift a small weight. The engine developed a power output of 1/10 watt, at an efficiency of about 20 percent. The engine also worked as a refrigeration unit, but these results were not spectacular.

LEEMER G. CERNOHLAVEK, Prague, Neb.

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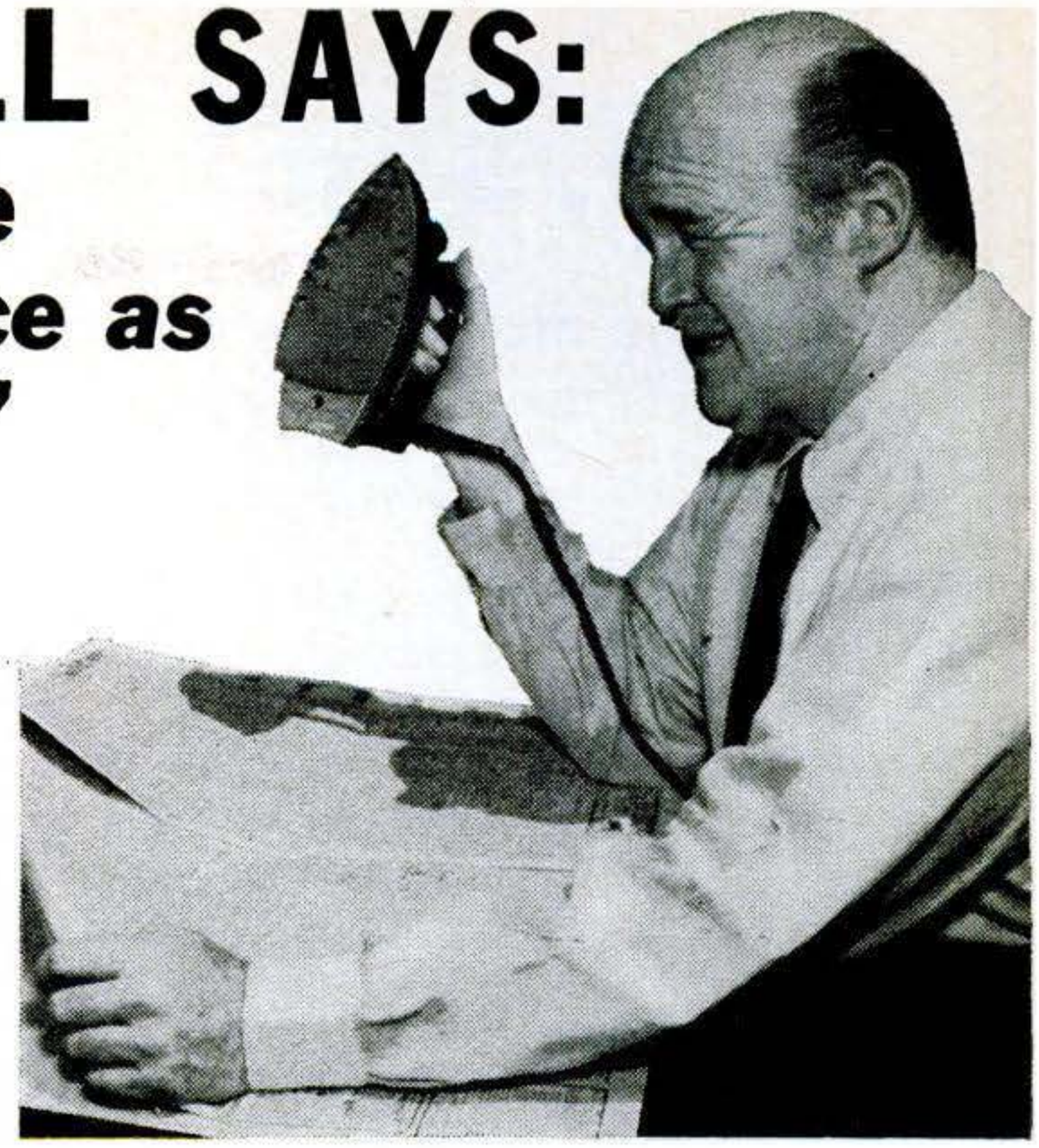
TOM McCAHILL SAYS:

"Good Appliance Repairmen are Scarce as Edsel Dealers!"



I don't think anything disturbs me as much as trying to find an appliance repairman . . . and finding out I'll have to wait my turn because he has more business than he can handle.

With over 400 million Appliances now in use, and more coming every year, there just are not enough repairmen around to take care of every Mrs. Jones who wants a broken Appliance mended in a hurry! And that's why a smart guy could really clean up in the Appliance repair field.

Some years back, almost anyone could do a fast repair on an iron or toaster with a bit of fancy tinkering. But today's complicated Appliances call for a special brand of know-how the average Joe doesn't have without training. Appliances are loaded with thermostat controls, solenoids, and special devices. Unless a repairman has a working knowledge of these parts, he won't even get to first base.

That's why I want you to take a good look at the home study course offered by the Appliance Division of the National Radio Institute. They show you all about repairing home and commercial Appliances—even farm Appliances and small gasoline engines. If you're interested, they also include a special package covering air-conditioning and refrigeration repairs. The cost is surprisingly low, and even includes a special Appliance Tester.

NRI is one of the biggest and best schools in the field, and has been around since 1914. They have a staff of 150 people in Washington, D.C., who are equipped to guide you through the easy course with expert and personal instruction.

Take it from Tom . . . this is one of the easiest and most rewarding fields a guy can enter today. You don't need a college education, you don't even need to know the first thing about Electrical Appliances when you begin your training.

There's nothing to lose . . . except the price of a stamp on your letter or postcard. Fill out the coupon below *now*, before you turn the page. Get the full rundown on the training that can increase your spare time income or provide you with a business of your own a lot sooner than you think. In just a few short months you could be ready to take the first profitable step towards a new and rewarding career. Do it!

Tom McCahill

TOM McCAHILL

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"Say, Smokey—"

A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please *print* your name and address.

Smokey confers with his driver, Curtis Turner, before start of a stock-car race.

"I changed the metering jets in my '66 Buick Six from .50 to .48. Will this harm the engine? Could I go smaller, say to .45, to better gas mileage? Performance is not important to me."

CHARLES SPERAN, Trenton, N.J.

Smaller jets than those the factory specifies can be a very touchy deal. You are asking for trouble that will outweigh any savings on gas.

"I am planning to buy a Mercedes-Benz with a diesel engine. What should I know about this type of engine beforehand? Are they hard to maintain? Are repairs more costly? What kind of mileage should I expect?"

JOHN TOMAKA, Lackawanna, N.Y.

They're not hard to maintain. The difficulty is finding qualified diesel mechanics. Parts at times are a problem. This is a good engine, though occasional repairs are more costly than for American gas engines. Mileage is very good. Engine torque at low speed is pretty miserable.

"How does a three-speed manual transmission with overdrive compare with a four-speed manual for ordinary driving? How does Chevrolet's manual transmission with overdrive rate?"

SPENCER ZITKA, Joliet, Ill.

Each has its advantages. Overdrive is best for economy and ease of driving. The four-speed is stronger and should be cheaper to maintain. Chevrolet's four-speed transmission is exceptionally rugged. The three-speed with overdrive is about as good as the other makes—they're all too easy to tear up if you don't know how to use them.

"I have a '62 Olds Cutlass with the aluminum engine. The only way to prevent radiator clogging, I am told, is to use the $6 Oldsmobile antifreeze. This will break me if it ever leaks. The active ingredient is probably soda ash—or something like that—at about 50 cents a pound at the drugstore. If you can tell me what it is, you probably can save me, and many other F-85, Rambler, and Tempest owners, a bundle."

STEVE COLLINS, Roselle Park, N.J.

A chemist I'm not. But if you ever discover that formula, I bet you'll find it a lot more complicated than that. Stopping corrosion in aluminum engines is a real problem, which is probably why nobody mass-produces them any more.

"After driving my 1965 Opel Kadett 20 or 30 miles the clutch develops a moderate chatter in low or reverse. Also, moderate to heavy braking at cruising speeds causes the front end to vibrate as though the drums are out of round. The car has only 2,100 miles on it."

WILLIAM L. FISCHER, Scott AFB, Ill.

I believe you have one of these clutch problems: a disk contaminated by oil or grease; the engine and transmission not properly fastened; a pressure plate not releasing evenly. I believe your brakes are as you suspect and need drum trueing with the lining arched to match.

"My 1960 Pontiac Safari wagon blows its top every few days, overheating. The last time, it caused leaks in the heater core. I've replaced and repaired everything connected with cooling, and I now run the car like a Model T—leaving the radiator cap loose and adding water daily."

J. S. DIENST, Wichita, Kan.

Everything? Hot engines can get that way for many reasons: 1) poor flow through the radiator, 2) loose fan belt, 3) bad thermostat, 4) leaking pressure cap, 5) leaking gaskets, 6) cracks in the cylinder head or block, 7) leaking core plugs, 8) late ignition timing. In addition, the front sheet metal, the fan shroud, or a mere addition of gadgets could be cutting the air

Continued

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flow. Finally, take a look at the lower radiator hose. It can collapse and cause the trouble.

"I'm having trouble with the alignment of the front wheels on my 1963 Chrysler Newport. Tires wear off fast on the inside. Three alignment machines have failed to correct it."

I. E. WILSON, Evergreen, Ala.

First, check all suspension parts, front and rear, for wear. See that there's no looseness. Load the car to the weight at which it is driven normally, then get an alignment to factory specs. Make sure the shocks are in good shape, and that tires carry the proper pressure. Your trouble—usually caused by "toe-in" or negative camber—should be over.

"I'm interested in a new Corvette for use in city driving and as a noncompetitive road car on twisty country roads. Would the increased weight of the 425-hp. engine over the 350 cause a significant decrease in cornering ability? Does the fast-ratio manual steering have much advantage over the fast-ratio power steering in terms of road feel and return action?"

MICHAEL S. CAHAN, Flushing, N.Y.

You'll like the big-engine performance, and it won't corner badly at all. A caution: Fast manual steering is not too good unless you are in the racy set. You'll get along easier with the fast power steering. Better yet, get variable-ratio power steering. That's the best.

"I've got flooding trouble with the two-barrel carb in my '65 Mercury. It seems that dealers, at the first sign of trouble, were instructed to replace the float needle with a nylon one. Now they're replacing the nylon with metal. If this doesn't work, they replace the metal float with a plastic one. None of this worked on my car, so they want to install a pressure regulator."

C. OLAJOS, Albuquerque, N.M.

A pressure regulator would help a little, but your real cure lies elsewhere. Your problem is heat. You have to keep the fuel cooler in the line between the fuel pump and carb, so it won't expand, shoving the needle off the seat. Replace the steel lines with fabric. Put in baffles to reflect heat away from fuel lines.

"We have over 12,000 miles on a '65 Mustang with four-speed transmission and 289-in. engine. We have difficulty keeping it in first during deceleration on grades. Our dealer has replaced synchronizers (three times), housing, and transmission plate, and made several gear changes."

CECIL H. DAVIDSON, Greenbrae, Calif.

Continued

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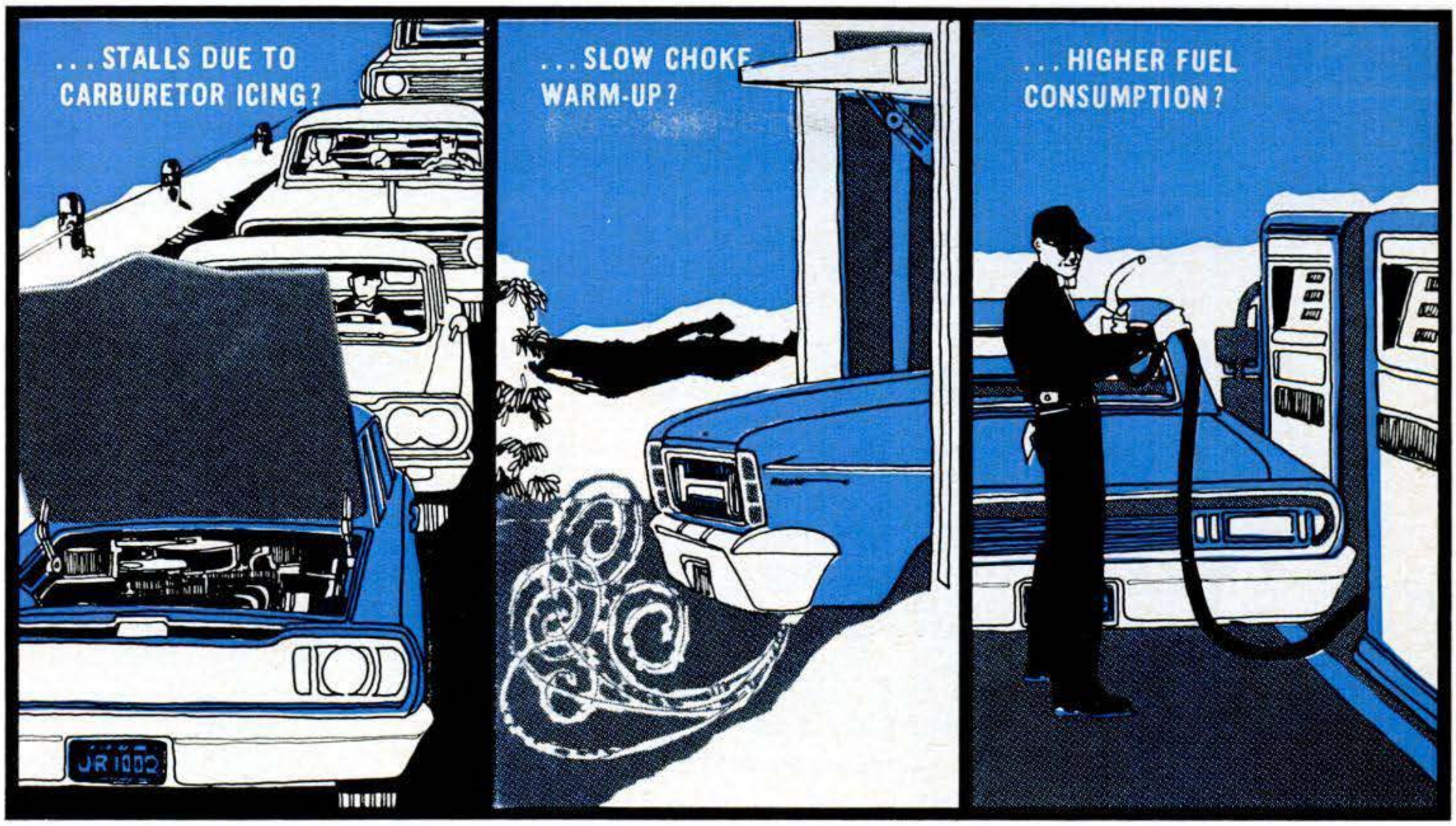
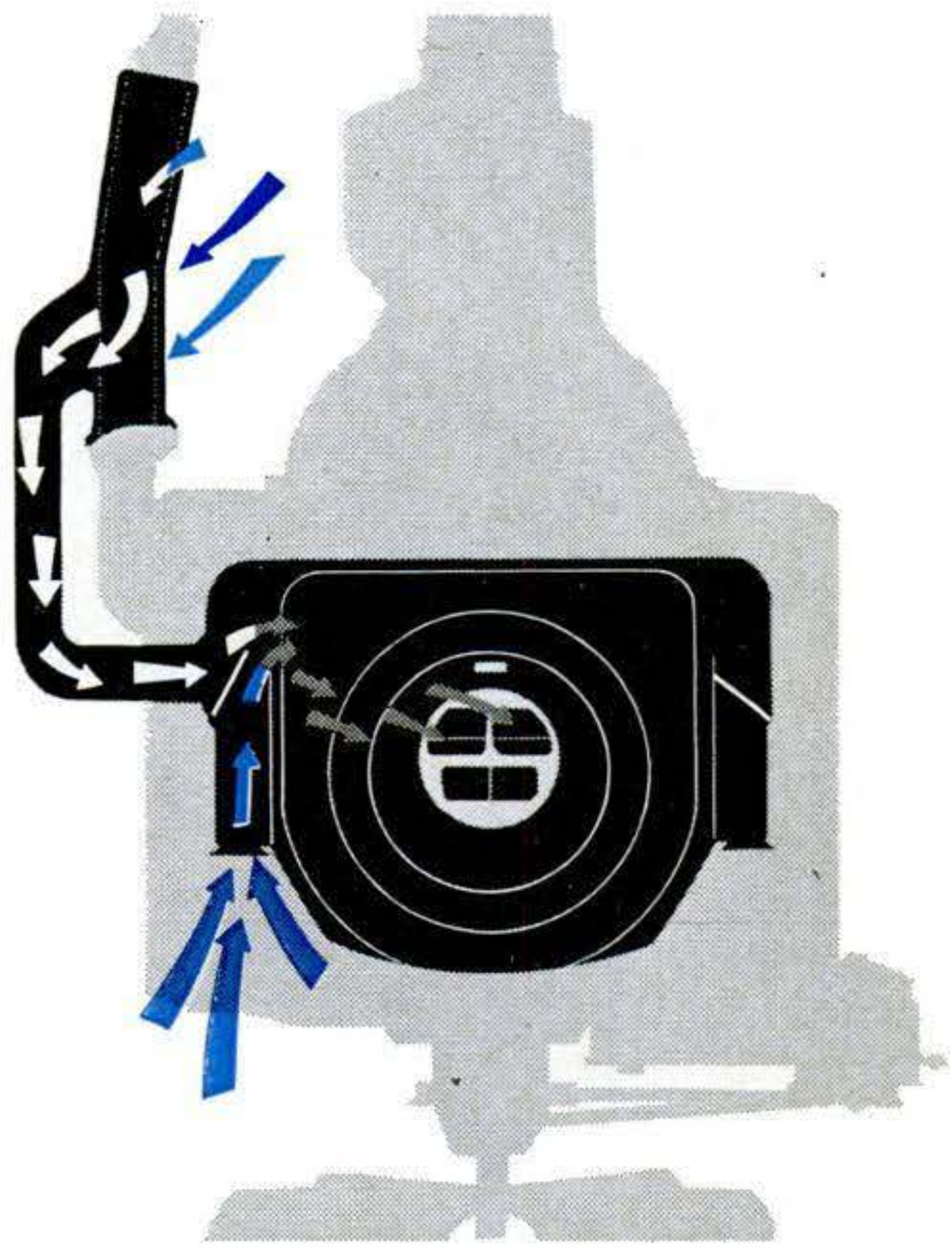
Remember those winter driving bugaboos . . .



OLDS MEETS THEM HEAD ON WITH ANOTHER ENGINEERING FIRST:

CLIMATIC COMBUSTION CONTROL

Winter used to be hard on a car (and on a car operating budget). Now Olds has turned the tables. New *Climatic Combustion Control* automatically mixes manifold heated air with underhood air at the carburetor to virtually eliminate carburetor icing, reduce choke warm-up time and cut fuel consumption in the bargain. It's available on any Rocket V-8 Engine. Another reason why the Rocket Action Cars are out front again!



Outside air (blue arrows) is preheated as it circulates around exhaust manifold. It is drawn through valve-diaphragm system to carburetor. Preheated air mixes with underhood air (white arrows) and is automatically regulated by thermostat providing constant carburetor air temperature. Preheat mechanism is bypassed when throttle is fully depressed.

OBEY LAWS DRIVE SAFELY

Olds thinks of your safety, too, with the GM-developed energy-absorbing steering column that can compress on severe impact up to 8¼ inches; with four-way hazard warning flasher; outside rearview mirror; dual master cylinder brake system, plus many other safety features—all standard for '67.

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'67 OLDSMOBILE

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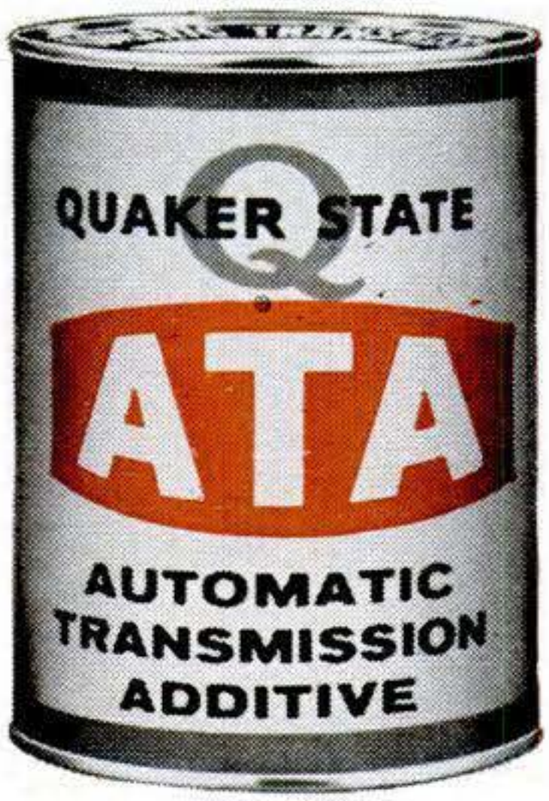
You can prevent automatic transmission leaks. Or at least help. With Quaker State ATA (Automatic Transmission Additive).

Prevents leaks. Quaker State ATA is an additive concentrate for all automatic transmission fluids. It softens and swells oil seals. Helps prevent leaks. And that's not all ATA does.

Protects transmissions. Quaker State ATA also revitalizes the fluid that's in your transmission. Revitalizes its anti-sludge and anti-varnish detergents. Renews its oiliness and friction control properties — helps your transmission shift more smoothly. All this plus helping stop leaks.

You should have used:



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"Say, Smokey—"
[*Continued*]

Check these possible causes: There may be a misalignment of the transmission and crankshaft, or the transmission case could have been machined out of specs. Possibly the transmission cover and shift mechanism are not putting the gears into full mesh. The detent springs in the cover could be at fault because of lack of tension, or the detents could be misaligned. One more thing to look for, if the above doesn't uncover the trouble, is a "floating" main shaft. There should be a solution among these.

"Please settle a long-standing argument. I contend that downshifting into second when approaching a corner at 20-25 m.p.h. is no harder on a car than taking your foot off the gas to slow down at 60-70 m.p.h. Dad just smiles and asks how many transmissions I've had to pay for in my Dart and Chrysler."

LARRY CROSSMAN JR., St. Clair Shores, Mich.

Well, how many? Seriously, I'll have to go along with your dad. When you downshift, you are straining the transmission and rear-axle assembly unnecessarily. Use the brakes to slow down. That's what they're for. Otherwise, you may be in for repair bills.

"I intend to install solid lifters in a Corvair. The adjustment for hydraulics is to bring the valve to the quietest point and add a three-quarter turn to get the lifter in the midrange position. Should solids be adjusted to the quietest point and left there?"

ROBERT L. LOTTERER, Baltimore, Md.

You're asking for trouble if you change over to solid lifters without changing the cam. Cams for hydraulic lifters are not made the same way —ramps and action are different. Solid lifters must have a preset clearance to compensate for heat, and this is ground into the cam.

"My 1964 International Travel-all with 304-cube V-8 and four-speed stick shift loses half its power at high altitudes (7,000 feet plus) where I drive it. Changing the jets in the carburetor for this is a lot of trouble. Is there a carburetor that makes jet adjustment, or the equivalent, possible on the dashboard?"

ERIC LEHTE, Oakland, Calif.

Not to my knowledge. I suppose the problem is so localized that manufacturers ignore it. Many aircraft-engine carbs have built-in mixture controls. Possibly you can adapt something like that.

Got a question on autos? Send it to:
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Science Newsfront

Last-minute news and notes to keep you up-to-date

By W. STEVENSON BACON

Scale measures weightless "weights" in space

How do you go about measuring "weight" (mass) in the weightlessness of outer space? This intriguing problem was recently solved by Air Force Capt. William E. Thornton Jr., M.D. His answer is to mechanically oscillate the unknown mass: The heavier the mass, the slower the oscillation rate. Thornton's unit includes an electronic timer, which times the first five cycles of oscillation; a reference chart then gives the mass. Both sensitive and accurate, the mass scale uses interchangeable parts to measure the mass of anything from a scrap of paper to a man. Its primary purpose is to permit medical researchers to monitor astronauts' body weight, food and fluid intake.

Plastic jet planes foreseen

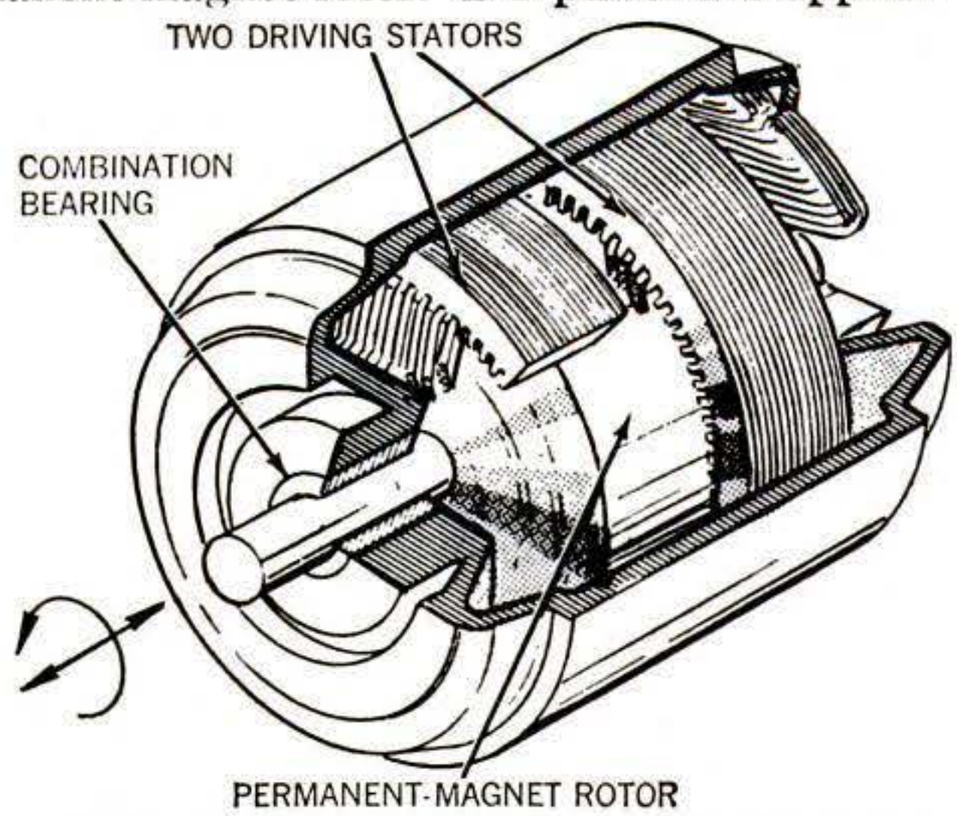
Jet transports made of crystalline-fiber-reinforced plastics could cut the weight of present subsonic transport planes by half and reduce fuel consumption by a staggering 80 percent. So says Dr. James Economy, of the Carborundum Co., who addressed a recent meeting of the American Chemical Society. The plastic materials would be half again as strong as steel, light in weight, and resistant to high temperatures. They would be reinforced with silicon carbide—the familiar compound of silicon and carbon used in grinding wheels—which can now be formed into whiskers. The whiskers are nearly perfect crystals, a structure that gives them enormous strength. With recently developed techniques, the whiskers can be made into yarns and imbedded in plastic.

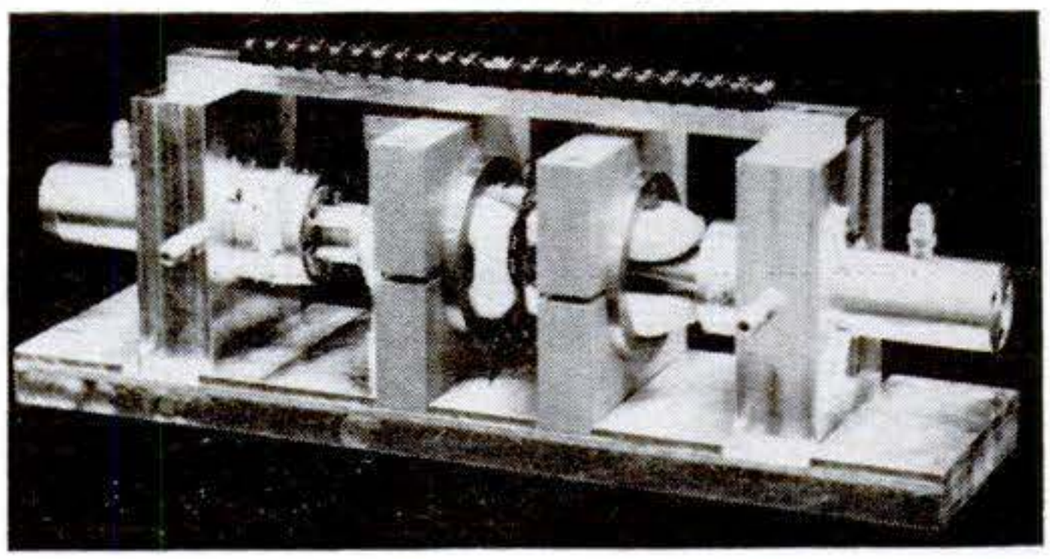
Alcohol attacks body chemistry

Exactly how does excessive drinking damage your health? It's due to a multiple attack of alcohol on the chemistry of the body, according to Dr. Edward Majchrowicz of the University of North Carolina, who spoke at a recent meeting of the American Chemical Society. First, drinking alcohol releases excessive amounts of fat materials from various storage sites, or depots, in the body. Secondly, the alcohol interferes with a normal process of the liver—burning of the fat to produce energy. A major reason that the liver cannot burn fat is that the needed oxygen is used instead to destroy alcohol. The net degenerative result is clinically observable as an increase in the lipid and fatty-acid level in the liver, heart, kidney, and other organs of the body.

3D motor rotates, pushes, and pulls

A unique 3D electric motor that can simultaneously rotate and push and pull a shaft has been invented by Stanley A. Cory of the International Telephone and Telegraph Corp. Designed to power such things as cutting tools, mixers, and winding machines, the motor uses twin stators in tandem, encircling one permanent magnet rotor. DC pulses are applied to





each stator in rapid succession. When the first stator is energized, the rotor rotates to line up with the developed magnetic poles of the first stator, and also moves axially to a position of minimum reluctance (minimum opposition between its magnetic field and the field set up by the stator). When the second stator is energized, the rotor again turns and also moves longitudinally to the new position of minimum reluctance. According to Cory, the motor's stroke can be adjusted within broad limits, and between one and 32 strokes per revolution are possible. Motors ranging from 1/1,000 to five horsepower appear practical.

Continued

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10 • **VON SCHRADER BUSINESS MANUAL** is complete; it tells everything you need know to make a success out of your venture, including how to go about getting business, suggested sales letters, who to call on, tips on keeping your books and tax records, suggested telephone book and newspaper advertisements, radio announcements, etc. Handout literature is also included.

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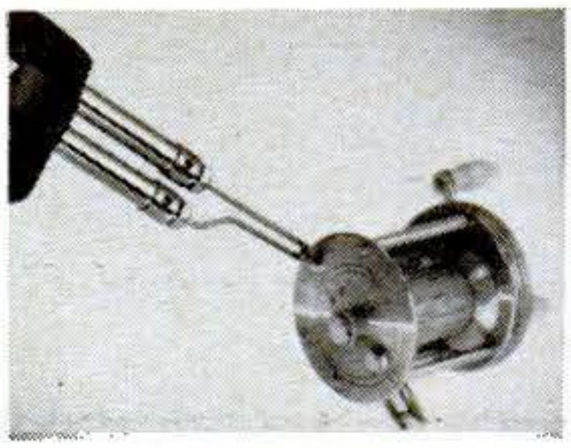

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Science Newsfront

[*Continued*]

Low-slung cars cut drivers' vision

Most U.S. cars are too close to the ground to let drivers see adequately—a factor that reduces highway safety, says Dr. Merrill J. Allen of Indiana University, a member of the General Services Administration advisory panel on auto safety standards. By bringing the vehicle close to the ground, the driver's line of vision is cut to two-thirds of that of a man walking, and the area lighted by the headlights is greatly reduced because of their lower height. The problem is further aggravated by the fact that the driver's eye level is so close to that of the lights that he sees more light than road. In a storm, the driver of a typical car will see raindrops clearly illuminated. A truck driver, on the other hand—three feet higher than his lights—sees much less of this "backscatter."

Tiny transmitters monitor life processes

Tiny radio transmitters that can be implanted in the body and are powered by its normal chemical and electrical processes are under development by Wen H. Ko, of the Case Institute of Technology, who recently received a grant from the National Institute of General Medical Sciences. The transmitters would make possible long-term monitoring of electrocardiograms, electroencephalograms, and other data. Ko has already succeeded in producing FM transmitters no larger than a shirt button to be implanted in the body to record heart activity of small animals.

New plane has engines in wings

A revolutionary new aircraft with the engines located *inside* the wings is being considered by the U.S. Air Force. Called the ADAM II propulsive wing, the craft has thick wings with ducts at front and rear. Vertically mounted turbofans inside would sweep the air through the wings to provide propulsion. At the trailing edge, movable flap ailerons would adjust from 20 degrees to 100 degrees downward; in the latter position, the thrust would make possible vertical takeoff and landing. A powered model of ADAM II will be constructed and wind-tunnel-tested by Ling-Temco-Vought Aerospace Corp., Dallas. The model will have 5¼-foot wings housing four tip-turbine fans simulating the unique propulsion system.

Passing drivers take 50-percent risk

Chances are that, at least half the time, drivers overestimate the interval they have in which to safely pass a car ahead with another vehicle coming from the opposite direction. This fact is borne out by a recent study conducted at the University of South Dakota in which 19 test drivers were asked to follow a

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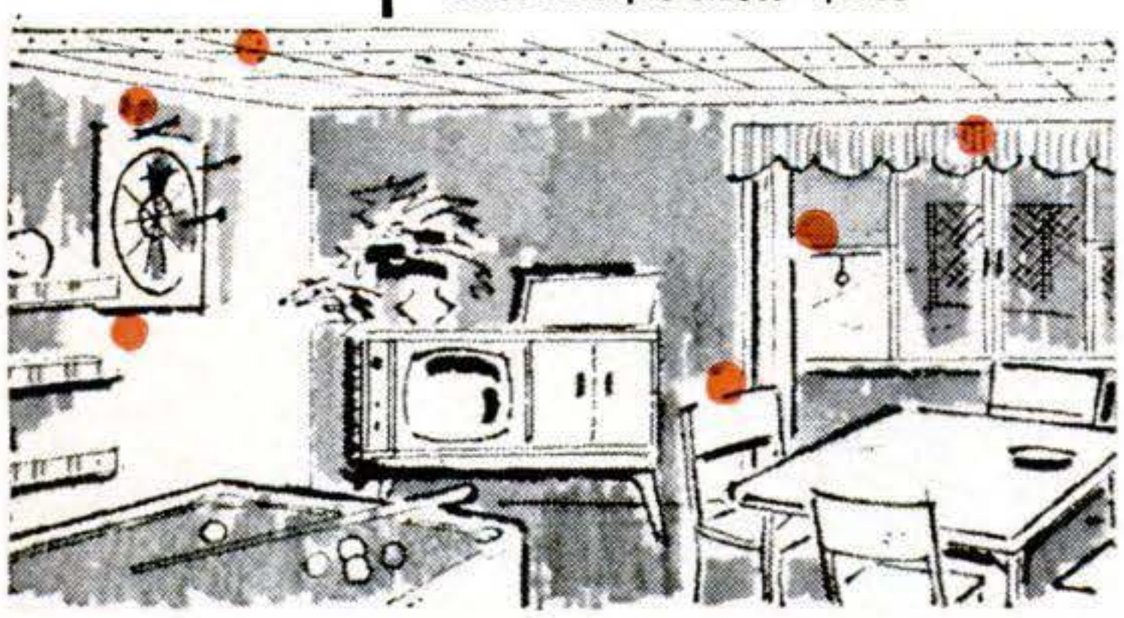

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[*Continued*]

lead car traveling at 60 m.p.h. Each time a car approached on the other side of the road, the driver was asked to indicate what he considered to be the last safe instant for passing. Speed and distance measurements indicated that of the 190 separate estimates, in only about half (97), would the driver have been able to pass without risking a serious accident.

Rocket fuel makes good roofs, roads

From the search for solid rocket fuels has come a material—thermoplastic rubber—that could be used for roofs, driveways, and roads, and as a lining for swimming pools. The compound, discovered by Dr. Frank J. Hendel of the Jet Propulsion Laboratory, consists of a mixture of asphalt, oil, and a common plastic. It has a rubbery consistency, can withstand temperatures from 100 degrees below to 180 degrees above zero, and has such a high tensile strength that it can be made in sheets like paper. Dr. Hendel sees his compound being used in road-width rolls; it could just be rolled out like a carpet on top of a suitably prepared foundation.

Instant photos for aerial reconnaissance

Film used to take aerial photos for the Air Force can now be processed in 30 seconds, without water, and produce both positive prints and a high-quality negative for later enlarging. The new photographic system, researched by Eastman Kodak, makes use of a film-like material that is laminated to the exposed film taken from an aerial camera. When the film and the secondary coating are peeled apart 30 seconds later, both a positive and a negative are available. The processing film is coated with a plastic base that contains development substances. Before use, it is soaked with a solution called an imbibant. No further steps are required. Both infrared and color films can be processed using the same technique, according to the Air Force.

To catch a thief: scented money

The next time a bank stickup takes place, the burglar had better be on his toes. A new way of tracing money—by a long-lasting odor applied to its surface—is likely to put the finger on him (or smell him out). The technique is the invention of Milton F. Allen of Decatur, Ga., who recently received a patent on it. Chemicals such as diacetyl, related to acetone, are kept in small tubes in bundles of bills. When the tubes are broken, either by a bank teller or by a thief, the bills are automatically scented. According to the inventor, police dogs in Atlanta are being trained to follow the distinct odor, and other cities are planning to follow suit. PS

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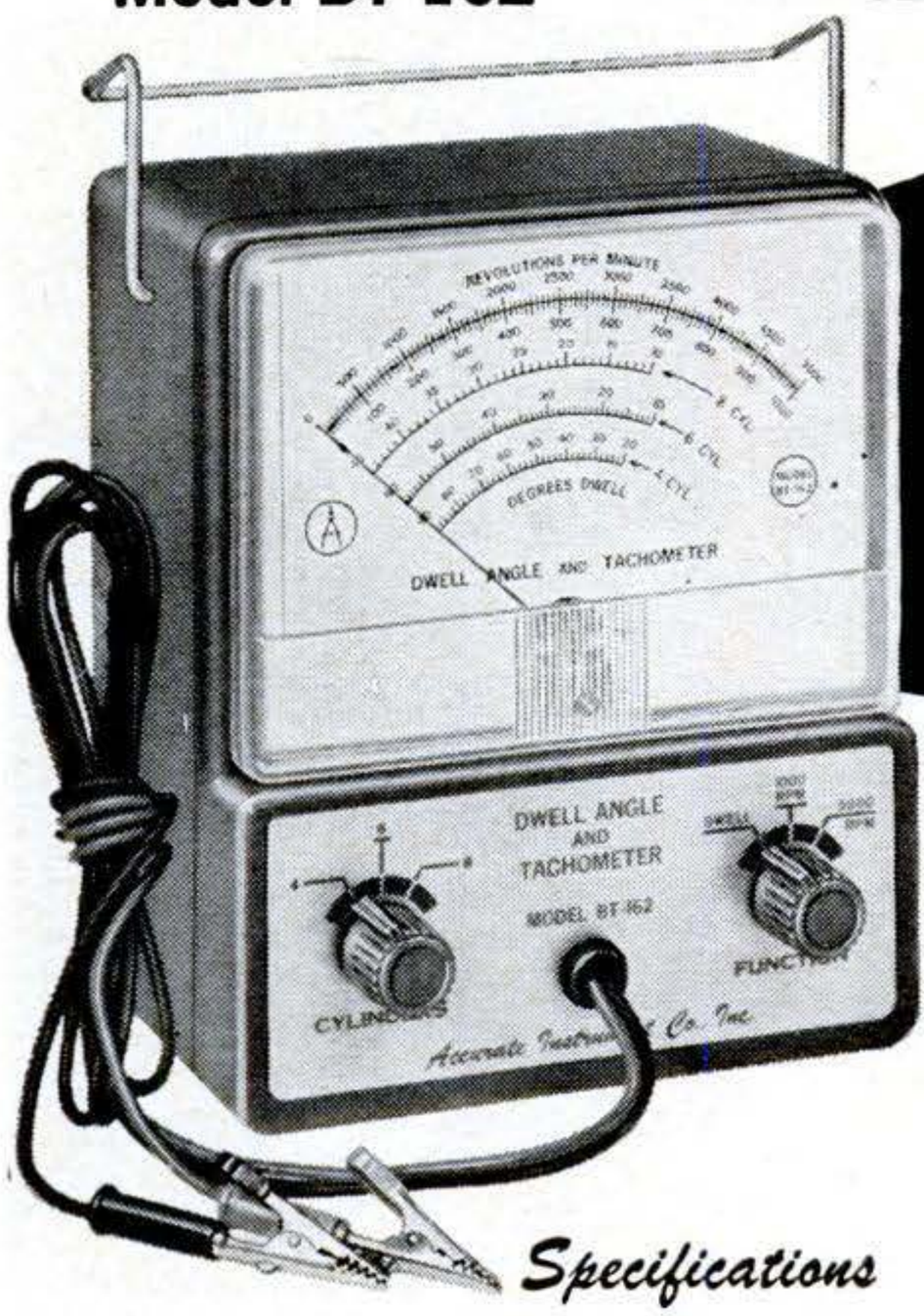

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The Model BT-162 provides three dwell angle scales; 0 to 45 degrees, 0 to 60 degrees, and 0 to 90 degrees. The three dwell angle ranges specified above make this instrument suitable for making accurate dwell angle adjustments on all 4 cylinder, 6 cylinder, and 8 cylinder cars, both foreign and domestic.

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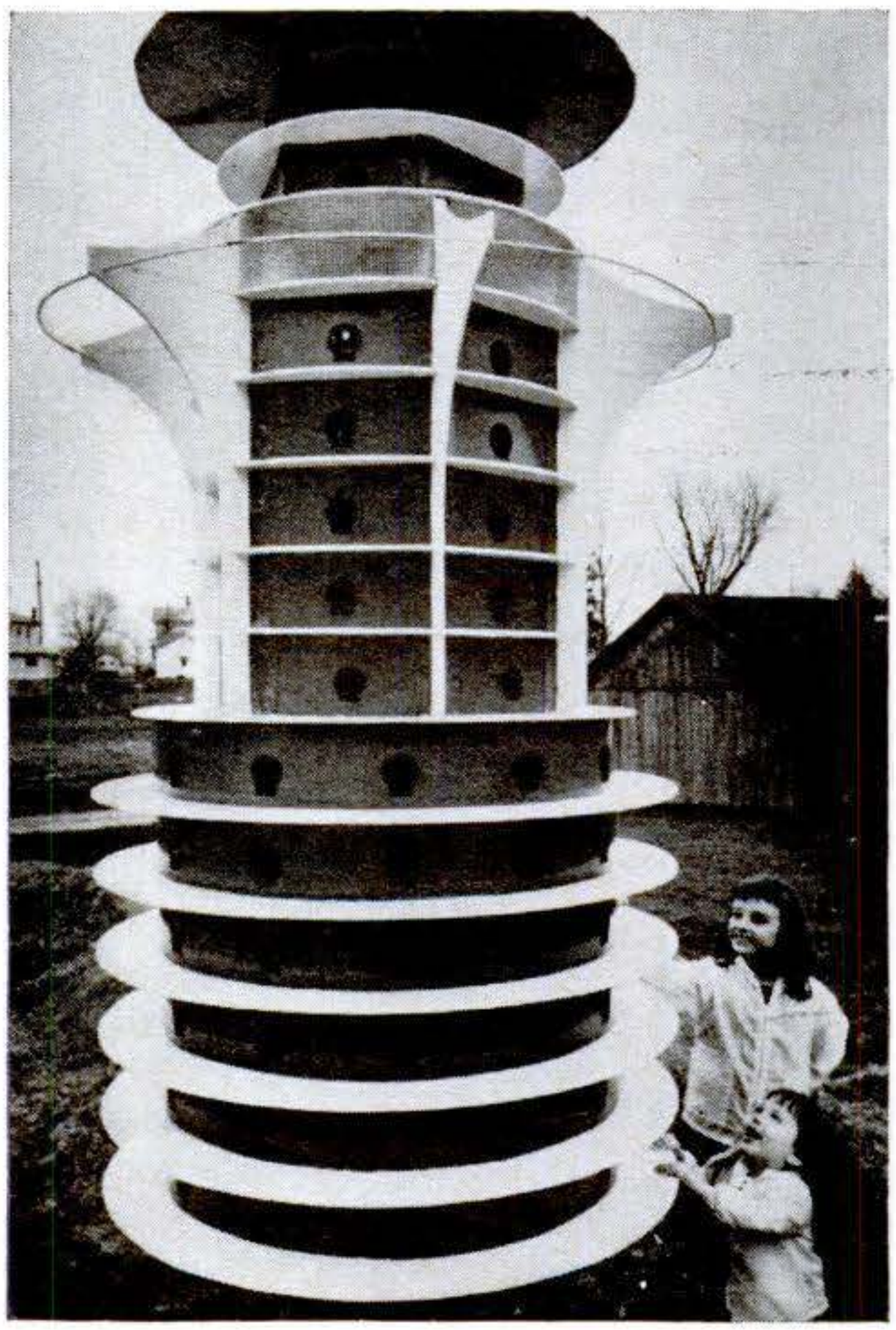

Birdhouse is 16 stories tall

A 16-story birdhouse mounted on a 21-foot pole has been built by Don Clum of Carroll, Ohio, for his two children. The tower is 11 feet high and offers 120 individual apartments for birds. Weighing 500 pounds, it's raised and lowered by a cable on its pole.

Bedspread looks like sports car

Covering a bed in a boy's room, a new spread looks like a sports car parked in the corner: hood, wheels, bucket seats. Shown is a Triumph Spitfire. Also made by Shapiro & Son Curtain Corp., 222 Fifth Ave., NYC: Mercedes, Austin-Healy, Volvo, Caravelle.

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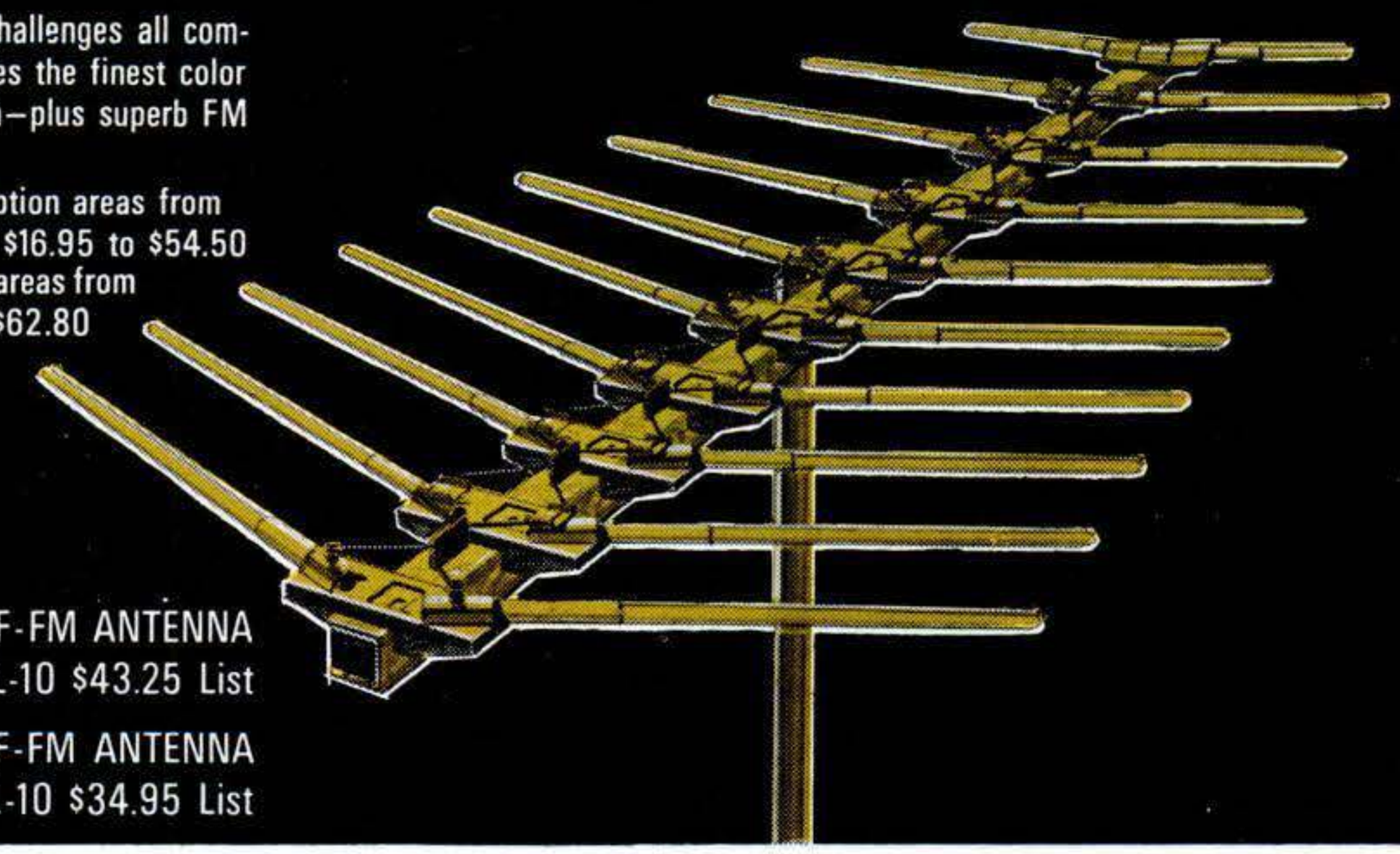

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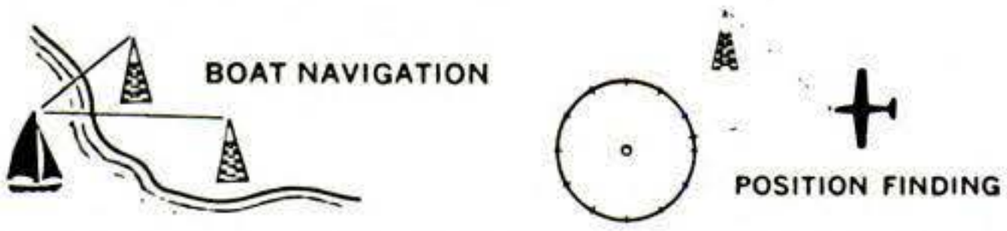

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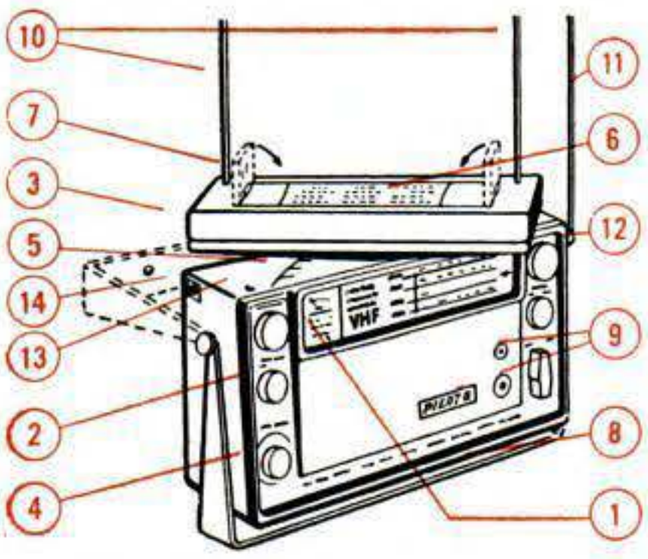

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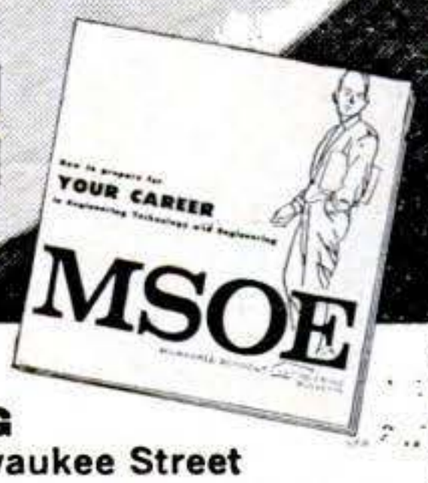

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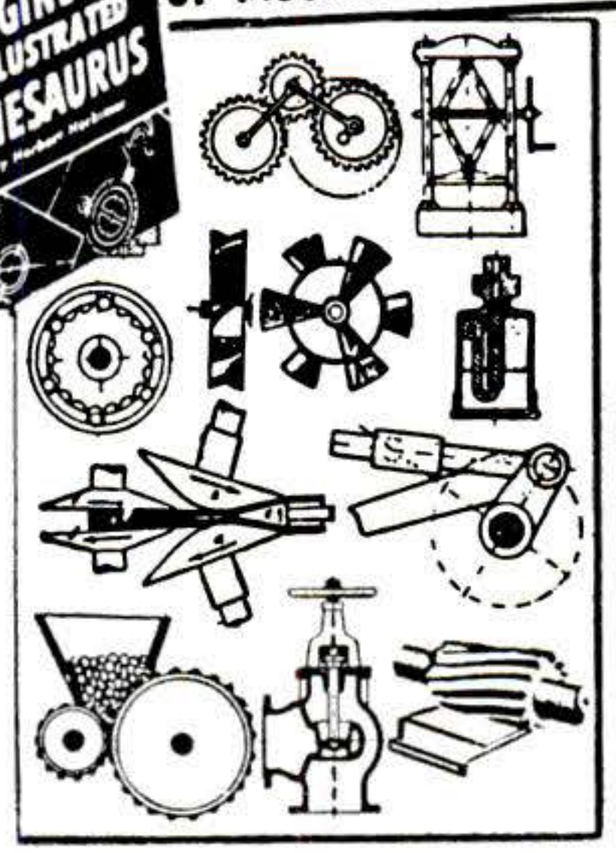

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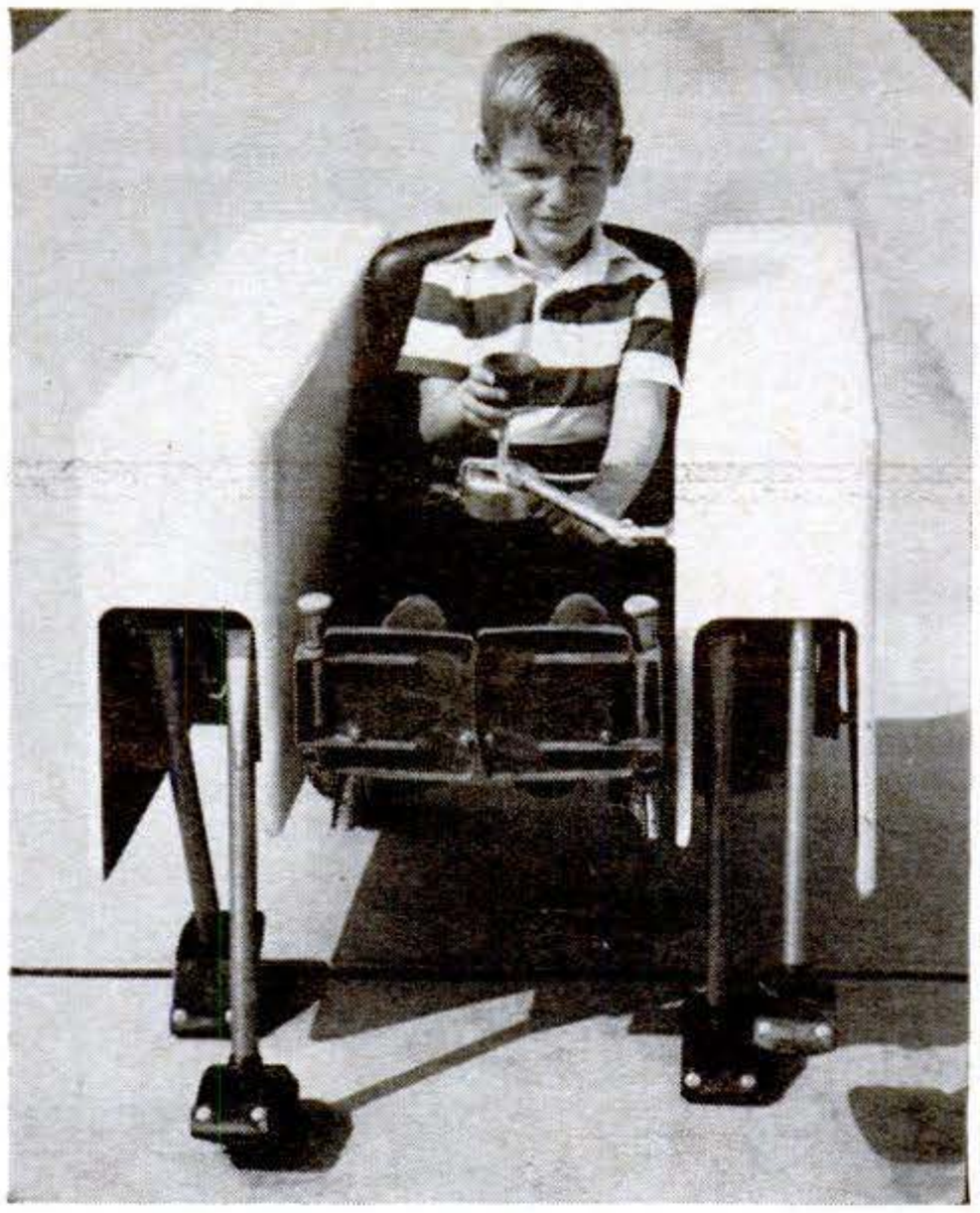

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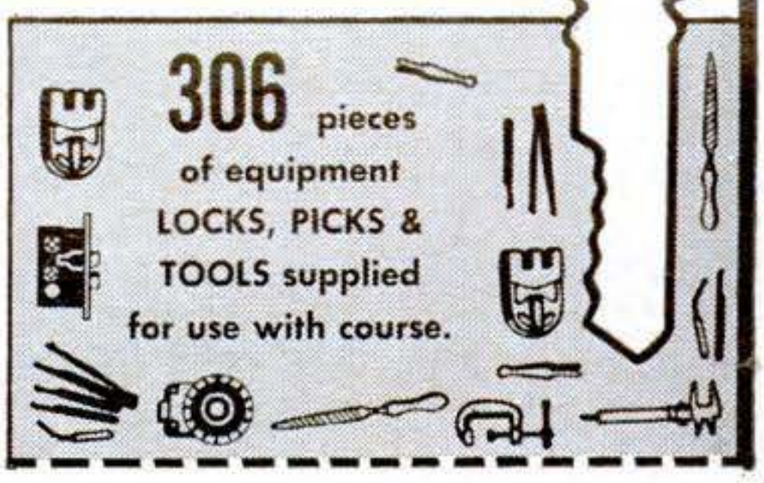

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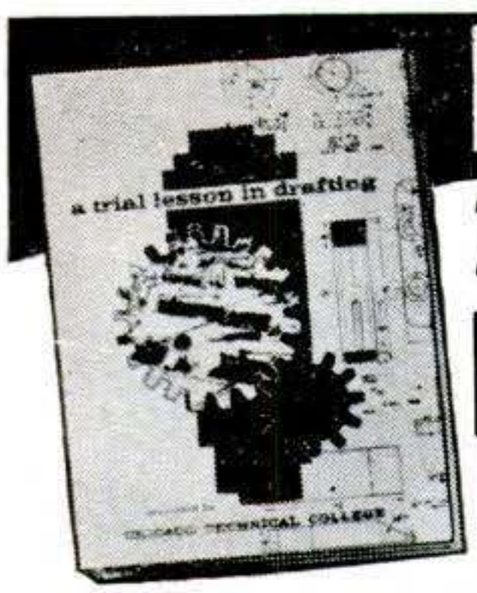

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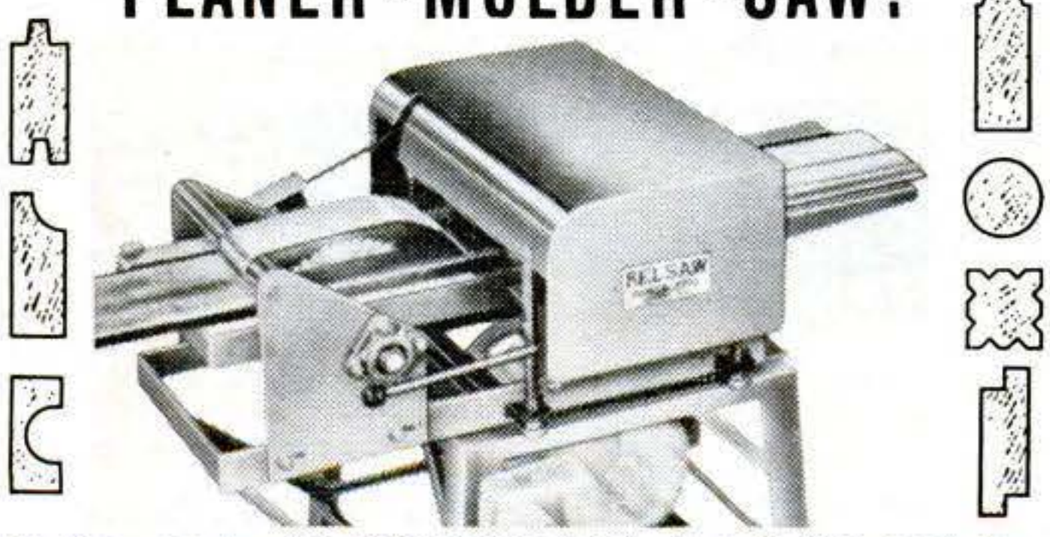

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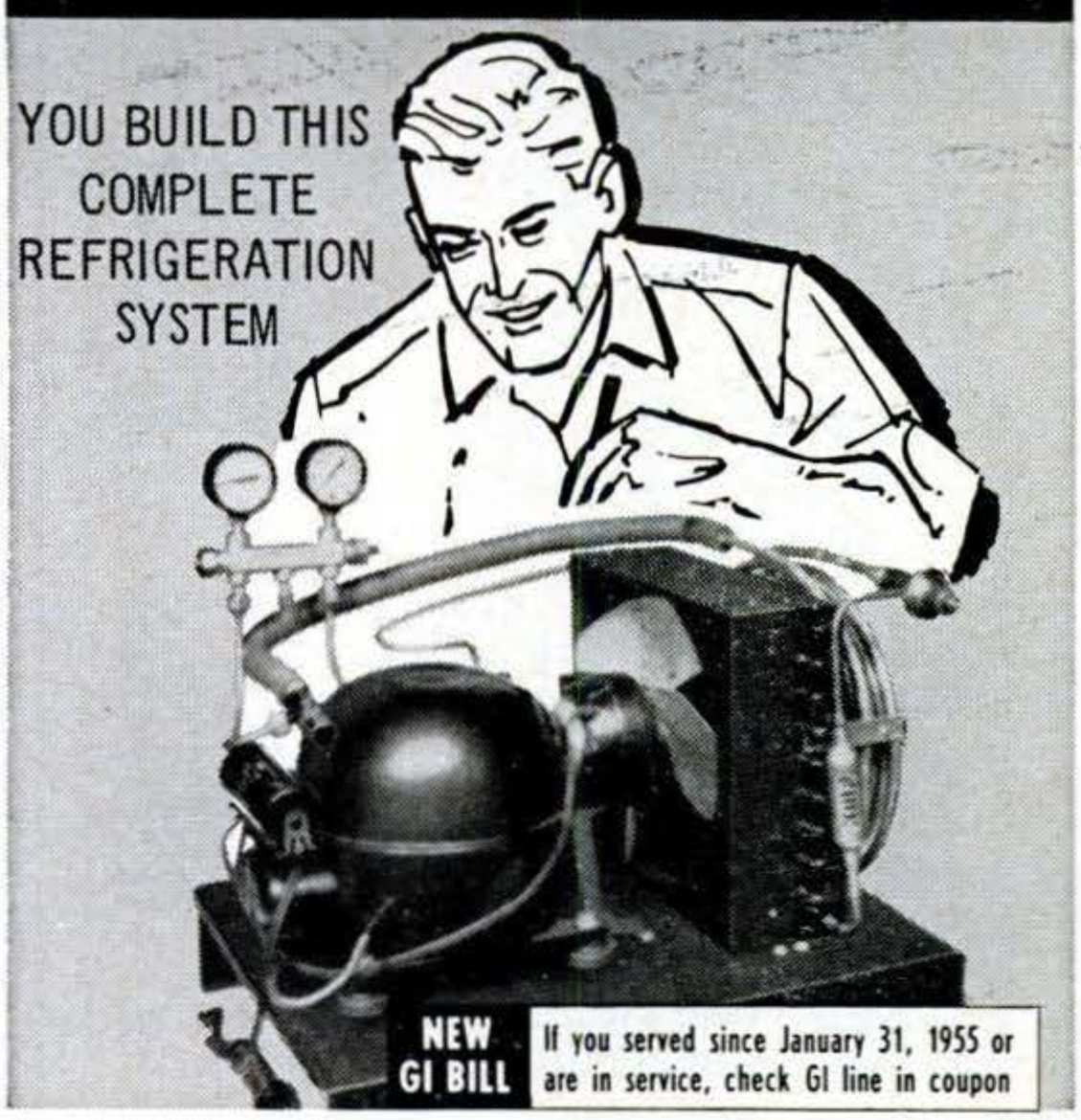

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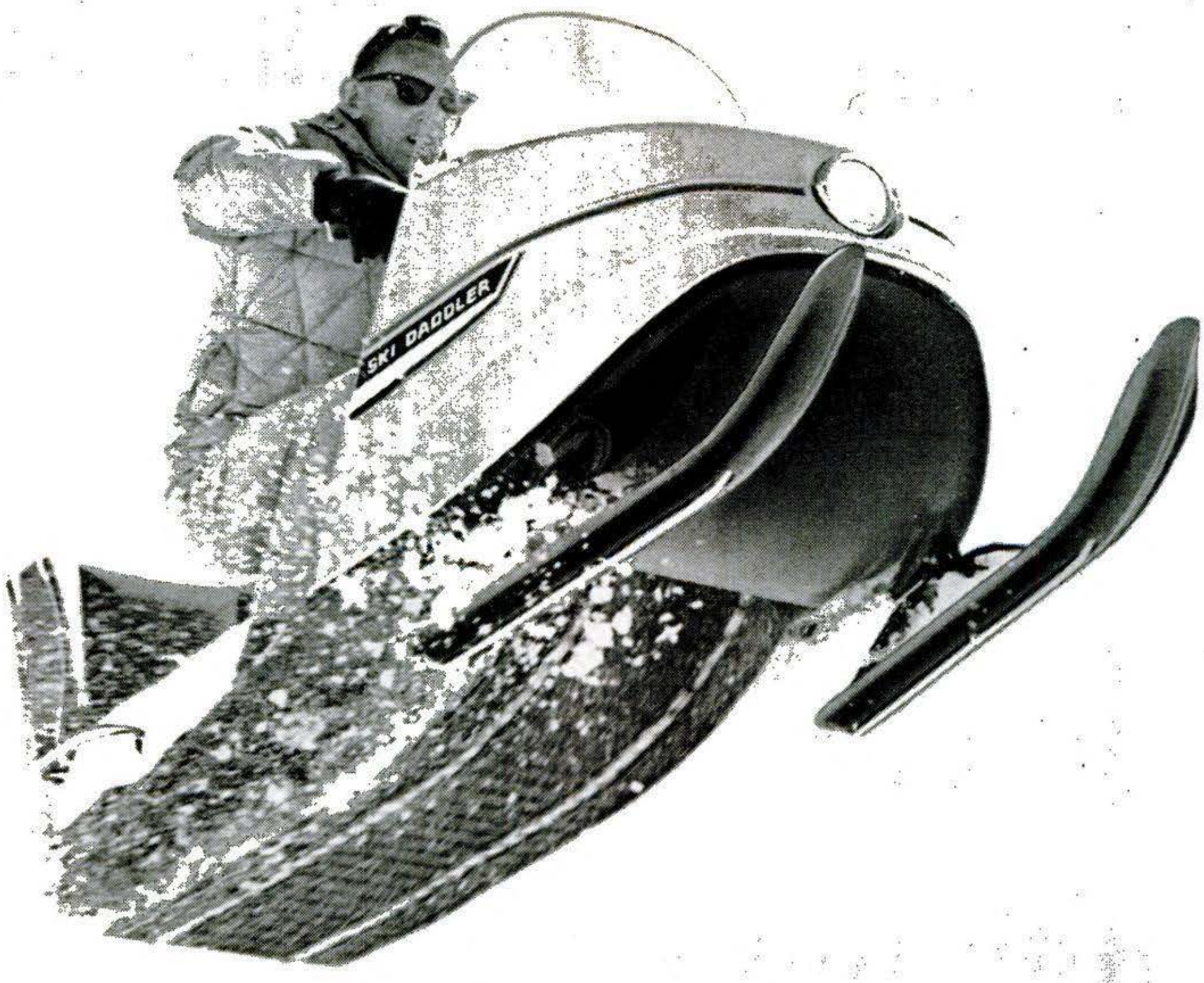

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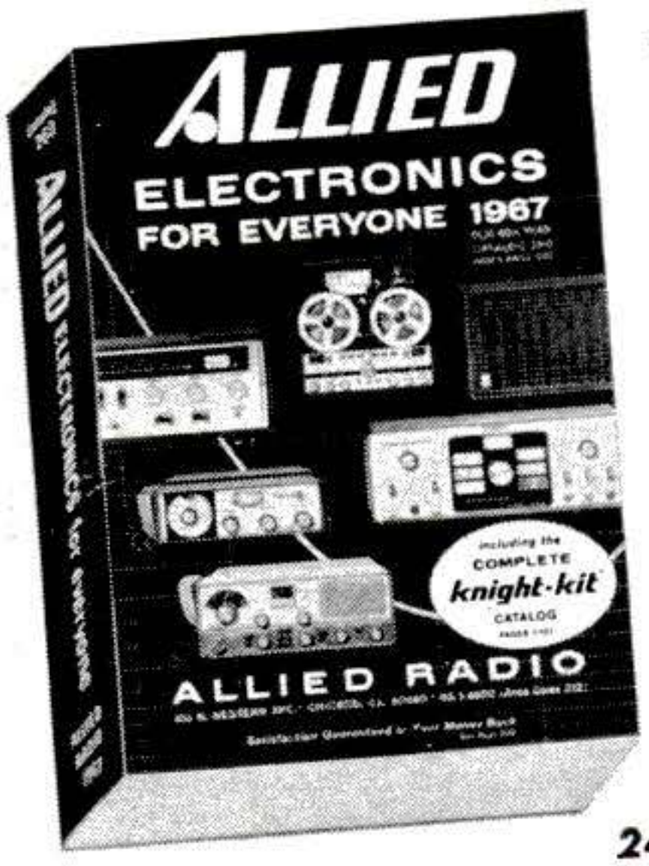

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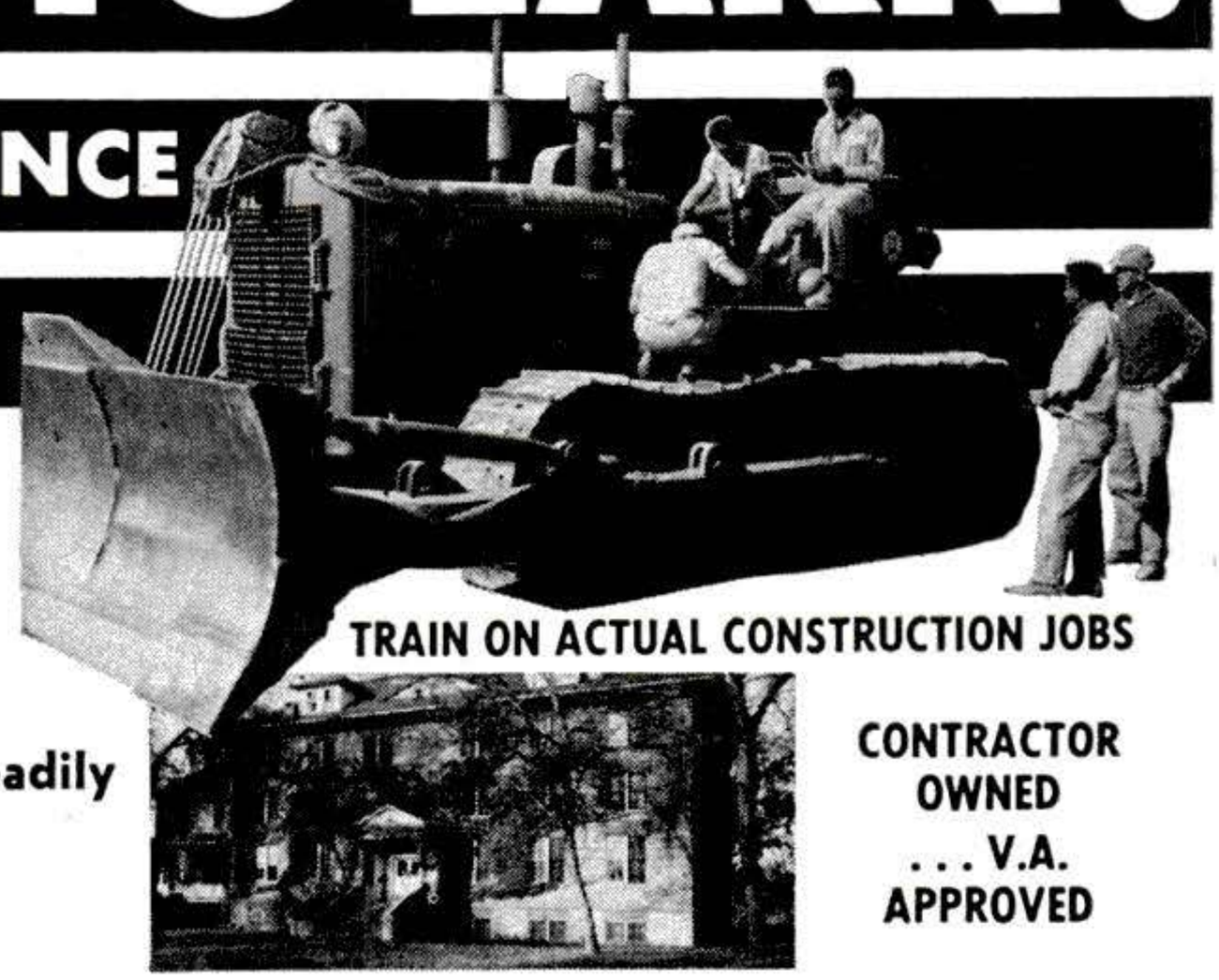

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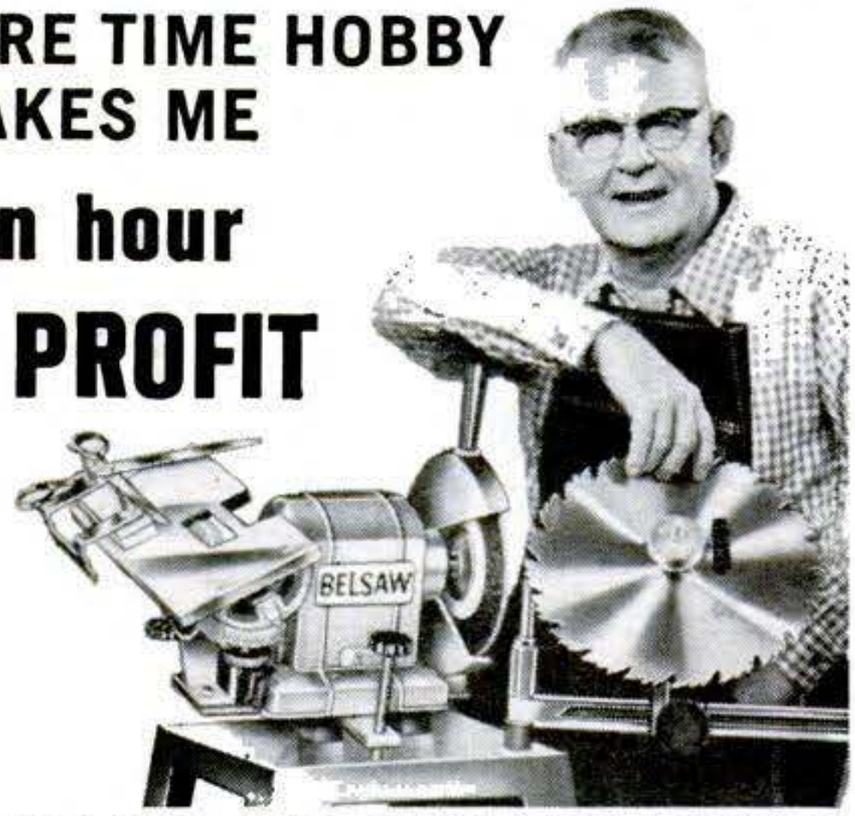

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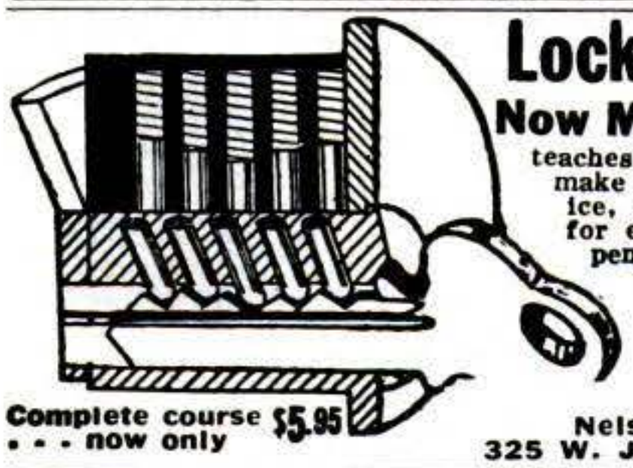

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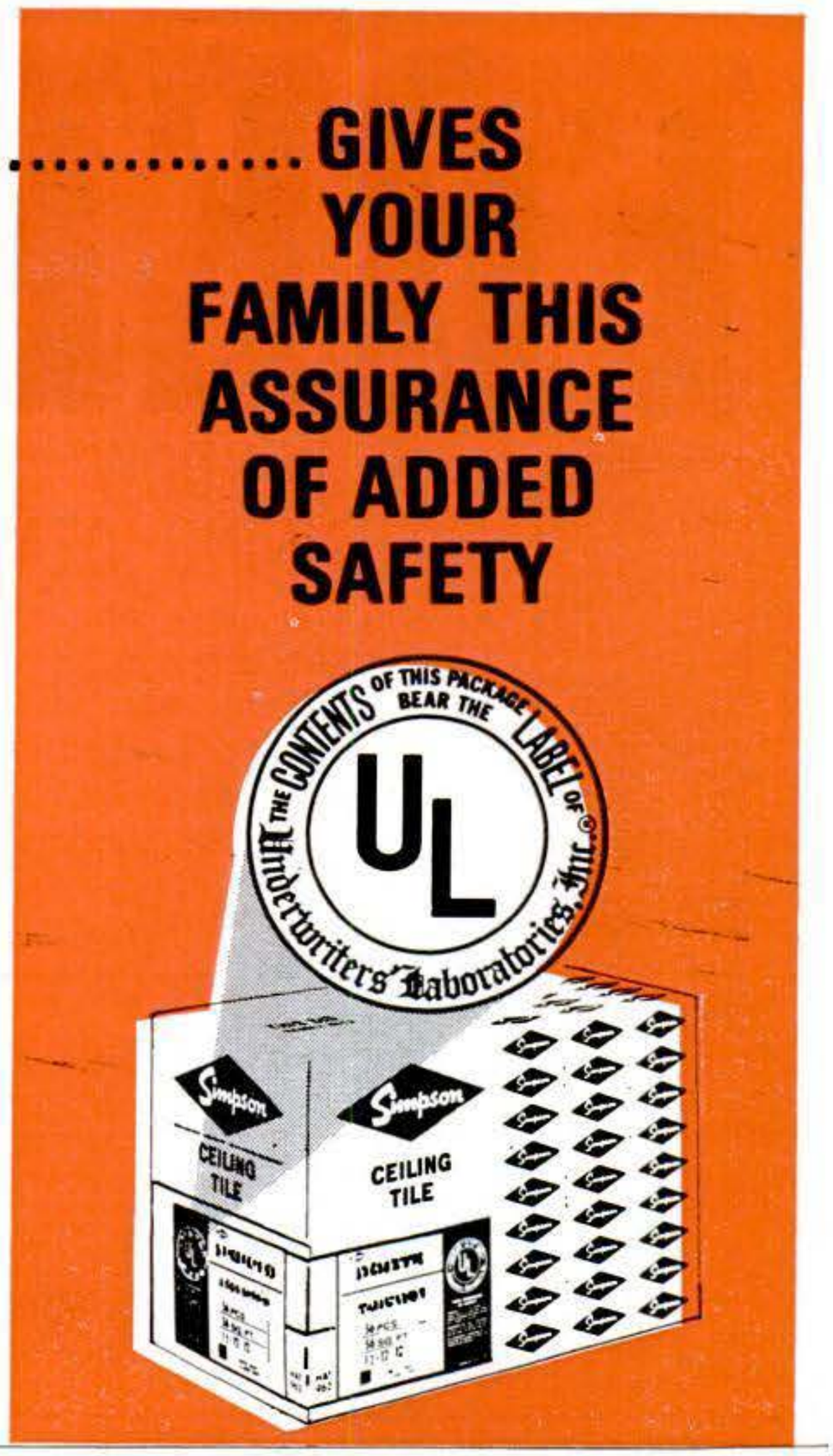

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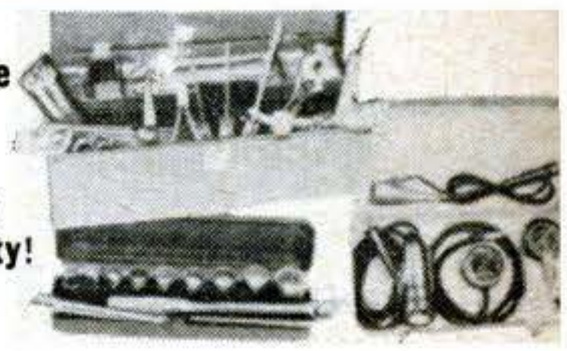

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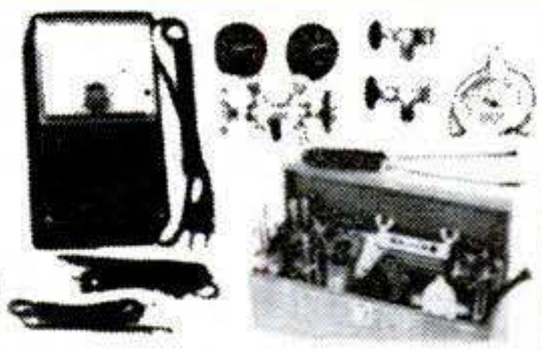

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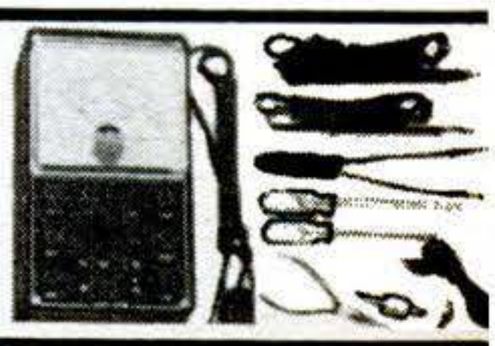

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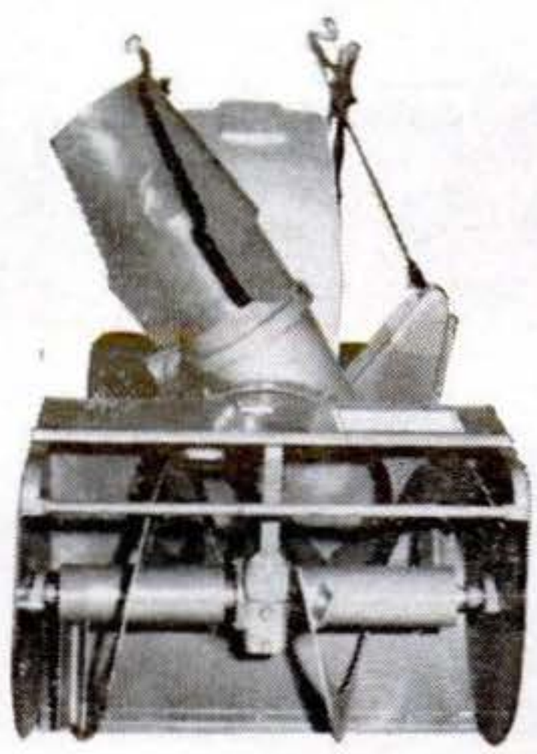

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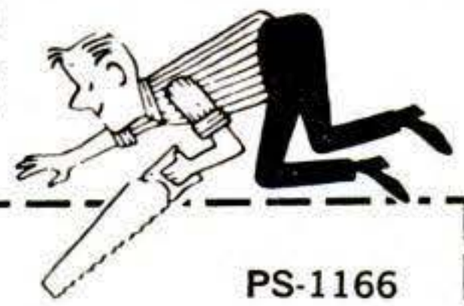

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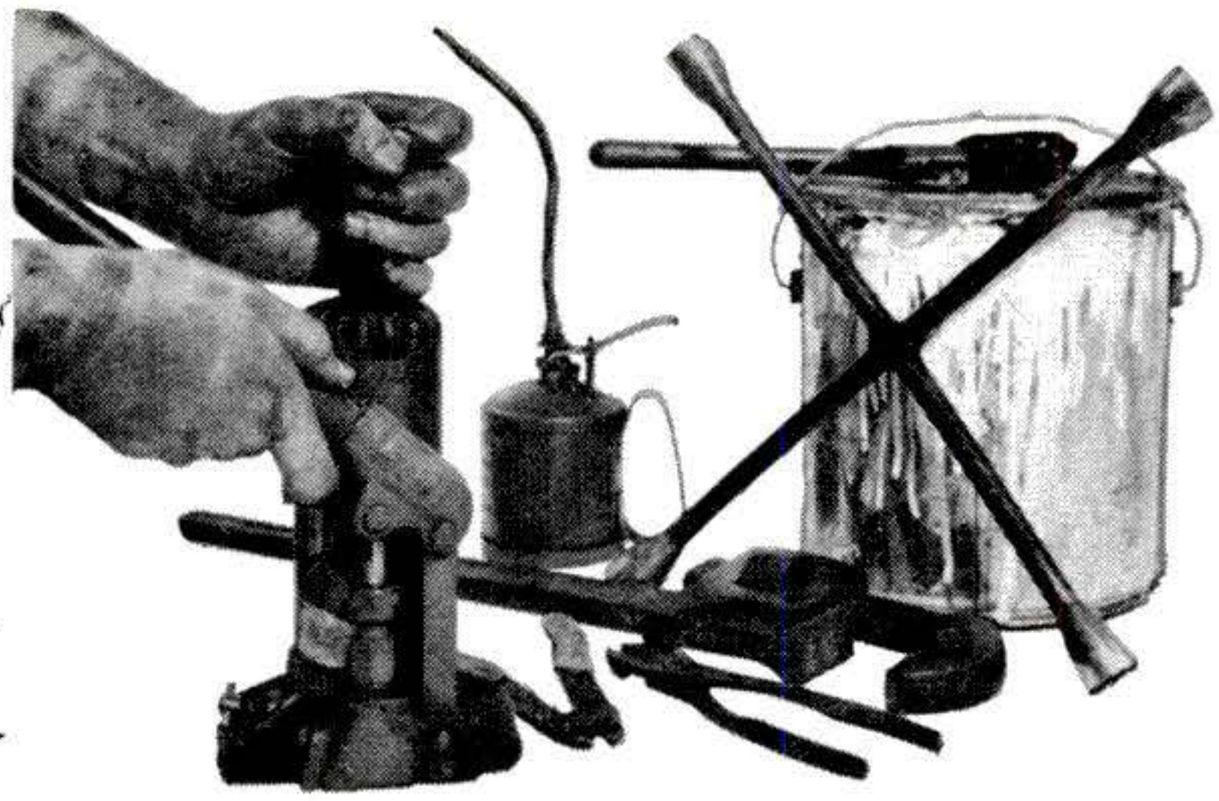

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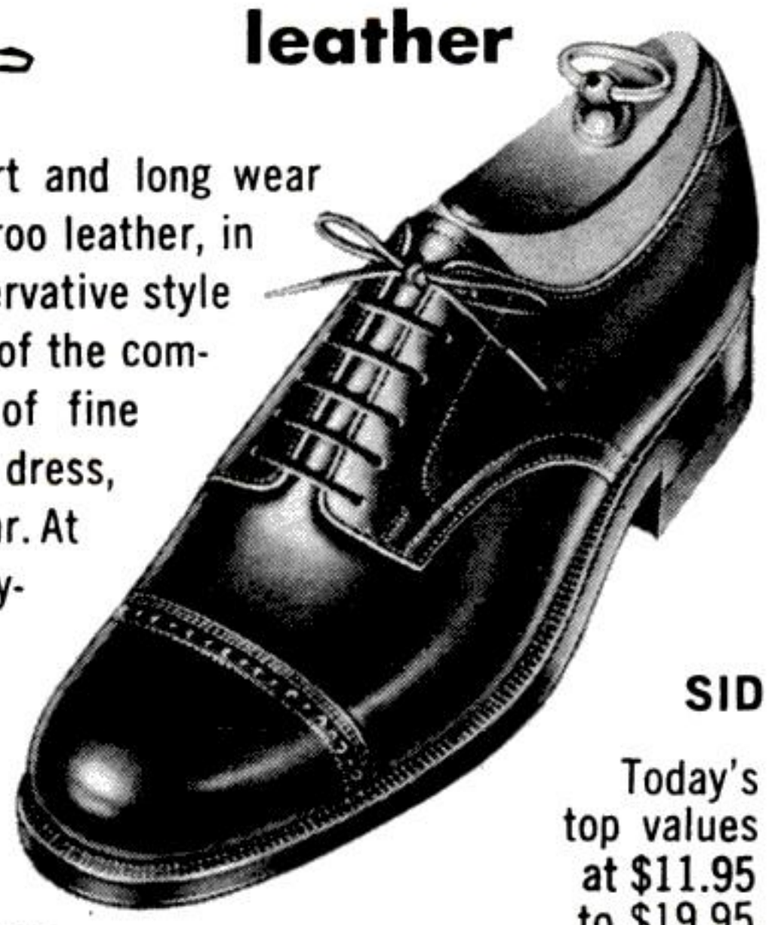

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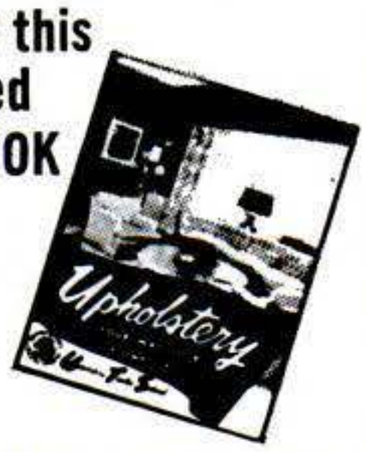

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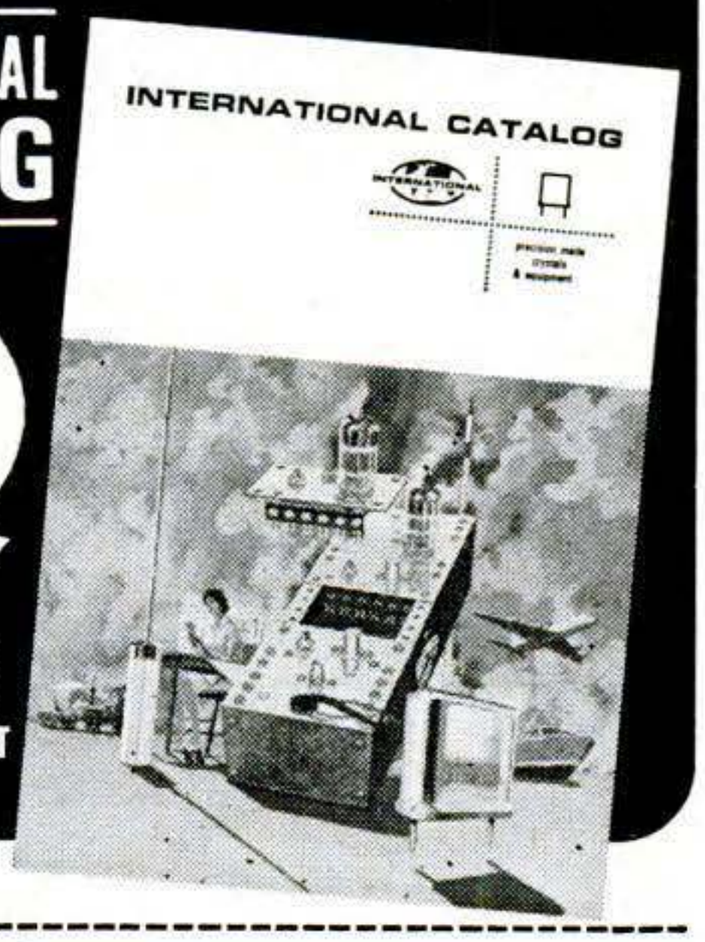

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The pride and satisfaction of building one of these most pipe-like of electronic organs can now be yours...starting for as low as $550. The Schober Spinet, only 38 inches wide, fits into the smallest living room. The all-new, all-transistor Schober Recital Model actually sounds like a fine pipe organ; its 32 voices, 6 couplers, 5 pitch registers delight professional musicians...making learning easy for beginners.

AND YOU SAVE 50% OR MORE BECAUSE YOU'RE BUYING DIRECTLY FROM THE MANUFACTURER AND PAYING ONLY FOR THE PARTS, NOT COSTLY LABOR.

It's easy to assemble a Schober Organ. No special skills or experience needed. No technical or musical knowledge either. Everything you need is furnished, including the know-how. You supply only simple hand tools and the time.

You can buy the organ section by section...so you needn't spend the whole amount at once.
You can begin playing in an hour, even if you've never played before—with the ingenious Pointer System, available from Schober.

Thousands of men and women—teen-agers, too—have already assembled Schober Organs. We're proud to say that many who could afford to buy *any* organ have chosen Schober because they preferred it musically.

Send for our free 1966 Schober Catalog, describing in detail the exciting Schober Organs and optional accessories; it includes a free 7-inch "sampler" record so you can hear before you buy.

THE *Schober Organ* CORPORATION

43 West 61st Street, New York, N. Y. 10023

Also available in Canada, Australia, Hong Kong, Mexico, Puerto Rico, and the United Kingdom

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☐ Please send me FREE 1966 Schober Catalog and FREE 7-inch "sampler" record.

☐ Enclosed find $2.00 for 10-inch quality LP record of Schober Organ music. ($2.00 refunded with purchase of first kit.)

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Detroit Report...

A DUMMY STEERING WHEEL FOR THE FRONT-SEAT PASSENGER? This may sound crazy, but some safety experts recommend it. While the auto makers have tried to design unconventional systems without steering wheels, a countermove proposes a padded wheel to cushion the impact of a driver thrown forward in an accident. So much backing exists for this idea that we may soon see similar devices to protect the front-seat passenger.

Rolls-Royce, look out! Here comes the Continental Mark X. Lincoln is building—for 1968½—a super-luxury car to compete with the highest priced imports. The Continental Mark X (10) will cost nearly $10,000. It is described as having a long, long hoodline, stretching even farther than the Eldorado's. The front is dominated by a massive radiator-shaped grille á la Rolls and Mercedes, heavily chromed and styled to stand out from the sheet-metal lines. Wheelbase of this six-seater four-door sedan will be about 130 inches.

"We'll build electric cars," says Ford. Are they serious? Absolutely. But don't hold your breath. The electric Ford is still in the very early stages of research, and actual plans are still on the drawing board. Before the plan can be implemented, a real breakthrough in fuel-cell technology must take place. Electric power is the goal of all Detroit's auto makers, and you may see electric cars on the road within 10 years. Detroit is so thrilled about electric drive that plans for gas turbines and Wankel engines have been held up.

Car bumpers as big as those boards on the front of wreckers? Yes, says Chrysler's chief safety engineer. That's what's really needed to protect a car in case of a front-end collision. The bumpers we have now are little more than parking protectors, do little to resist impact in an accident. Stylists are trying to contour these outsize bumpers of the future into pleasing lines to blend with the body contours. Bumper costs will soar.

Ford's four-door T-bird has sparked the competition. Riviera and Toronado will have four-door models next year. But don't look for convertibles in these cars in the near future. Ford says '66 T-bird convertibles made up only 10 percent of Thunderbird sales. The industry average for convertibles is five percent, but even twice that is hardly enough to justify the extra manufacturing costs. When the next convertible T-bird appears, the top will be all metal.

Will the "Safety Race" ever reach the intensity of the "Horsepower Race" of recent years? Ask any auto maker's representative and he'll clam up. "We can't even acknowledge that you asked that question," one told me. "There are all sorts of things Washington can accuse us of." Supposing GM develops a safety device and uses it exclusively to get a competitive advantage over AMC, Ford, and Chrysler. GM could be accused of holding back life-saving advances. On the other hand, if all the companies agree to bring out a new safety feature at the same time, the government might accuse them of conspiring to regulate the introduction of these devices to their own advantage. Right now the industry is in the middle, and will be as long as Washington keeps the safety pressure on.

Ford got the jump on everybody by making radial-ply tires optional on the '67 models. Rumors say Ford has contracted for the entire output of radial-ply tires from four tire companies (Firestone, Goodyear, Goodrich, and U.S. Royal). What will Chevy do? Nobody knows where they'll get the tires, but they plan to offer radial plies later in the year. Chevy will definitely go big on radial-ply tires for '68. Chrysler was caught off guard, too, but Dodge is planning to make radial-ply tires available on the Dart early next year.

A front drive for Volkswagen? The possibility has been raised because VW continues to use a rear engine and swing axles (which Chevrolet is being sued for using on the 1960-64 Corvair as alleged "unsafe design"). The fact is that VW already has a front-drive car in production—it's called Audi. Built by VW's wholly owned Auto Union subsidiary, it has a four-cylinder water-cooled engine. But the Audi is a $2,500 car and no Beetle substitute.

Jim Dunne

Detroit Editor

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Please don't swipe our decals!

STP®

It's not necessary. *The easiest and fastest way to get your Big Red Decal is to drop us a stamped, self-addressed envelope. While they're free, STP decals seem to be disappearing from the cars of some of our staunchest fans. This is the work of decal peeler-offers, and, rather than nail up reward posters, we prefer to send out free STP decals.*

In case you're wondering why there are so many Big Red Decals around, we put together a list of users that includes the first eight place winners at the Indy '500', drag champions from coast-to-coast, sports car types, record holders at Bonneville and practically everybody who's anybody in any kind of auto racing. These men count on STP Oil Treatment to protect the performance of their engines under the toughest conditions. They know that STP coats moving parts with a film of protection that keeps their engines running smoother, quieter and longer.

So take a tip from the pros—and millions and millions of motorists in cars like yours. Next time you need oil . . . every time you change oil . . . add STP Oil Treatment. At Service Stations everywhere.

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YOU CAN'T CUT WOOD WITH EXPENSIVE "TAIL FINS" AND CHROME-PLATED GIMMICKS!

Henry Ford had the idea in the twenties when he mass produced an economy automobile and said "Give them any color they want as long as it's black". Rambler and Volkswagen had the idea when they substituted sound engineering, simplicity and cost-cutting techniques for built-in obsolescence, phony status symbols and useless adornments!

American Machine & Tool Co. has pursued the same policy to bring to the public LOW COST POWER SAWS THAT PERFORM EVERY OPERATION OF MACHINES SELLING FOR MANY TIMES THE PRICE!

We have proved that the elimination of unnecessary parts makes for simpler operation, and less chance for machine failure . . . that the elimination of excess metal and weight takes nothing from the durability of the machine . . . that the elimination of triple-plated chrome gimmicks takes nothing away from the function of the machine, only from the cost . . . that sound creative engineering has far outstripped esthetic design in achieving efficiency, accuracy, performance and ease of operation in power saws . . . that the public is tired of being oversold on "gingerbread" that they cannot possibly use.

WE HAVE PROVED IT OVER HALF-A-MILLION TIMES

We have proved it with hobbyists and men who make wood products for profit in spare or full time . . . with industrial maintenance men and thousands of once-in-a-while handymen.

We took our machines to the shops and crafts editors of America's leading consumer magazines such as Popular Mechanics and Popular Science. **Read what Popular Science said in July 1962 . . . "Just how good can economy tools be? The table saw, drill press and jointer—were purchased by POPULAR SCIENCE and put through the same demanding jobs expected of other shop tools. The results were surprising. Rugged but frill-less. What you get for your money is a combination of clever engineering and a stern lack of luxuries . . . the machines, in our opinion, give surprisingly good value".**

WHAT KIND OF MIRACLE MEN ARE WE?

We're not. We are just good engineers. Our careers are devoted to designing and building good power tools. We know the public does not want to be clobbered at every turn with useless and costly gimmicks. We design for simplicity, quality, performance, accuracy. Our plant is geared for mass production economies. We sell direct from our factory to the public. These are the reasons for our "miracles". Every other power tool maker has the chance to do the same for you. Only difference is WE DO IT!

PATENTED ENGINEERING DEVELOPMENTS MAKE BIG DIFFERENCE!

U. S. Patents 2471733, 2590035, 2651337 covering 3 basic inventions are the key to the exceptional performance, accuracy, capacity and economy of the AMCO 8" tilt arbor power saw, making it in every way as functional as units costing many times more. No other saw manufacturer today, American or foreign, markets a unit like ours at anywhere near the price. Check for yourself, feature for feature: 11" x 13" ground cast iron table that stays level, while blade tilts to 50°; patented tilt control mechanism and lock with accurate etched scale; blade raises and lowers 0" to 2¼"; patented motor mount takes any standard ¼ h.p. or larger motor, keeps belt tight, assures transmission of full power and perfect alignment at any angle; saw insert removes for insertion of standard dadoe heads, cutters, etc.; takes standard blade (not included); accurately scaled mitre gauge is included.

FILL IN AND MAIL THE MONEY-SAVING COUPON TODAY.

American Machine & Tool Co., Dept. PS-116, Royersford, Pa.

- ☐ Send 8" Tilt Arbor Power Saw at $14.95.
- ☐ Include Standard Rip Fence #354 at $3.50.
- ☐ or Longer Rip Fence #354C at $4.50 (for use with cabinet base)
- ☐ Payment in full enclosed $..... or
- ☐ $3 deposit enclosed, balance C.O.D. I MUST BE FULLY SATISFIED OR WILL RETURN WITHIN 10 DAYS FOR FULL REFUND. No questions asked.
- ☐ Send FREE catalog of America's greatest power tool values.

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Saw Unit Mounted in Cabinet Base Made from FREE plans furnished.

ONLY $14.95 f.o.b. factory (wt.: 25 lbs.)

You receive completely assembled cast iron and steel 8" Tilt Arbor Power Saw with ground cast iron table, less blade. If desired, for easier work alignment, add $3.50 for standard length RIP FENCE for use with bench saw as del'd; $4.50 for extra long Rip Fence for use with cabinet base.

HOW MUCH IS A CABINET BASE WORTH?

We don't think the sensible buyer wants to wind up with a floor cabinet saw costing $250-$300. We don't believe the added convenience is worth the whopping difference. If you prefer or need more than a fully assembled bench top saw (which is the way ours is shipped), we have designed a completely functional cabinet base in which you can incorporate the AMCO saw as illustrated. The plans are absolutely FREE . . . and it takes only a sheet of ¾" plywood, about 4 hours of your time to complete it. Use the AMCO saw to make all cuts. You'll have a 27" x 24" work surface and a convenient table height of 33", plus a pullout sawdust bin and a tool compartment. Spend $250 for a floor cabinet base saw? Why . . . when you can do the same job for so very little!

YOU DON'T TAKE CHANCES WHEN YOU BUY BY MAIL

American Machine & Tool Co., like every other responsible manufacturer selling by the mail, is anxious that you be fully satisfied. So we give you TWO guarantees: One, we ask you to look at the AMCO saw . . . examine it, use it as much as you wish. If, within 10 days, for **any** reason, you are not completely satisfied, return it to us (freight collect) and we'll promptly send you a full refund . . . no questions asked. Two . . . we give you an iron-clad 10-year factory guarantee that protects you against faulty parts or workmanship. So, even in 8 or 9 years, if a bearing burns out, return it. AMCO will replace it at no cost to you!

No manufacturer can long stay in business with such guarantees unless his product is 100% as represented. American Machine & Tool Co. has been doing business like this for 32 years.

If you'd like a power saw and have a healthy respect for your hard-earned money . . . you won't buy one until you have tried the AMCO 8" tilt arbor power saw at $14.95

FREE! CATALOG OF AMERICA'S GREATEST POWER TOOL VALUES!

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Compare. You'll find, as have many thousands of others, that NRI "3 Dimensional" training can't be equalled. From the delivery of your first lessons in the remarkable new Achievement Kit we send you, to "bite-size" easily read texts and carefully designed training equipment . . . NRI gives you more value. Everything you see below is included in just one low cost NRI course. Other major courses are as complete. Text for text, kit for kit, dollar for dollar — your best home-study buy is NRI.

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When you enroll with NRI we deliver to your door everything you need to make a fast start in the Electronics field of your choice. This remarkable new starter kit is an outstanding, logical way to introduce you to NRI training kits; an unparalleled example of the value of NRI home-study training. What's in it? Your first group of lesson texts; a rich, vinyl desk folder; NRI's valuable Radio-TV Electronics Dictionary; important reference texts; lesson answer sheets; envelopes; pencils; pen; ruler and even postage. No other school has anything like it. Start your training this absorbing, exciting way.

ELECTRONICS COMES ALIVE WITH CUSTOM TRAINING KITS

Get your hands on actual parts and build, experiment, explore, discover. NRI pioneered and perfected the "home lab" technique of learning at home in spare time. Nothing is as effective as learning by doing. That's why NRI puts emphasis on equipment, why it invites comparison with equipment offered by any other school. Begin now this exciting program of practical learning. It's the most rewarding way to prepare for a career in Electronics. It's the best way to understand fully the skills of the finest technicians — and make their techniques your own. It's the priceless "third dimension" in NRI's training method.

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From Achievement Kit to custom TV kit, everything shown below is yours when you enroll for NRI's Radio-TV Servicing Course. Other NRI courses are just as complete. But NRI training is more than kits and texts. It is many personal services, too. Mail postage-free card.

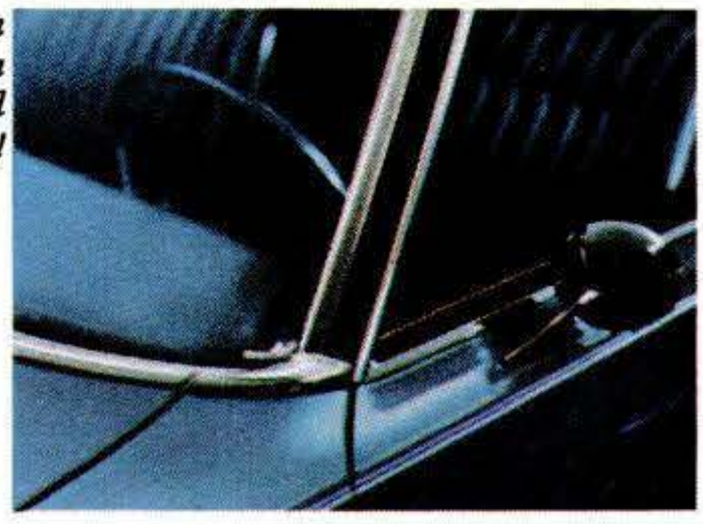
The Bonneville 4-Door Hardtop. Have we done it again? Of course we have!

You're looking at the most beautiful Pontiac ever to ride on Wide-Track. (And we've had nothing but winners.) It's completely new from the distinctive sculpturing of the famous split grille to the slickest engineering innovation in years—disappearing windshield wipers. (They only come out when it rains.) And only Pontiac has them.

There are new 400 and 428 cubic inch V-8s. New standard safety features such as free wheeling door locks on all doors, the energy absorbing steering column developed by General Motors, front seat belt retractors, and a four-way hazard warning flasher. New options you can order such as front wheel disc brakes, a bi-level air conditioner that can cool your head and warm your toes at the same time, and an AM-FM stereo radio that sounds great even in an open convertible.

Ride the Wide-Track winning streak.

No vent windows on the Grand Prix! Just a beautiful, uncluttered picture window!



Headlights on the Grand Prix hide behind the grille. Parking lights are hidden, too.

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The Great One. GTO Hardtop. Need we say more?

Pontiac Motor Division

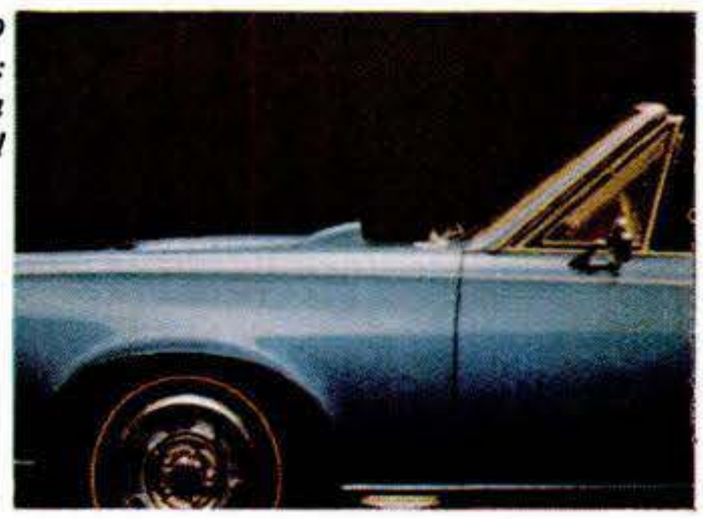
The incomparable GTO for '67 comes with 400 cubic inches of engine under a magnificently refined new skin. Or you can order the 255-hp version or the fabulous new 360-hp Quadra-Power Four Hundred. And for the first time you can order your GTO with our famous three-speed Turbo Hydra-Matic.

Our revolutionary 165-hp Overhead Cam Six is standard on all Le Mans and Tempests. You can specify the 215-hp 4-bbl version, a spirited 250-hp regular gas V-8 or its 285-hp premium gas cousin. Or you can step into the neatest grand touring car this side of the Atlantic with our OHC 6 Sprint package. Also new for this year—Executive and Tempest Safari station wagons with walnut wood grain styled paneling. All this plus the road-hugging security of Wide-Track on every Pontiac we make. See your Pontiac dealer right now.

Wide-Track Pontiac/67

You can add full fidelity sound by ordering our eight-track stereo tape player.

Leave it to Pontiac to come up with it first: now you can order a hood-mounted tach!



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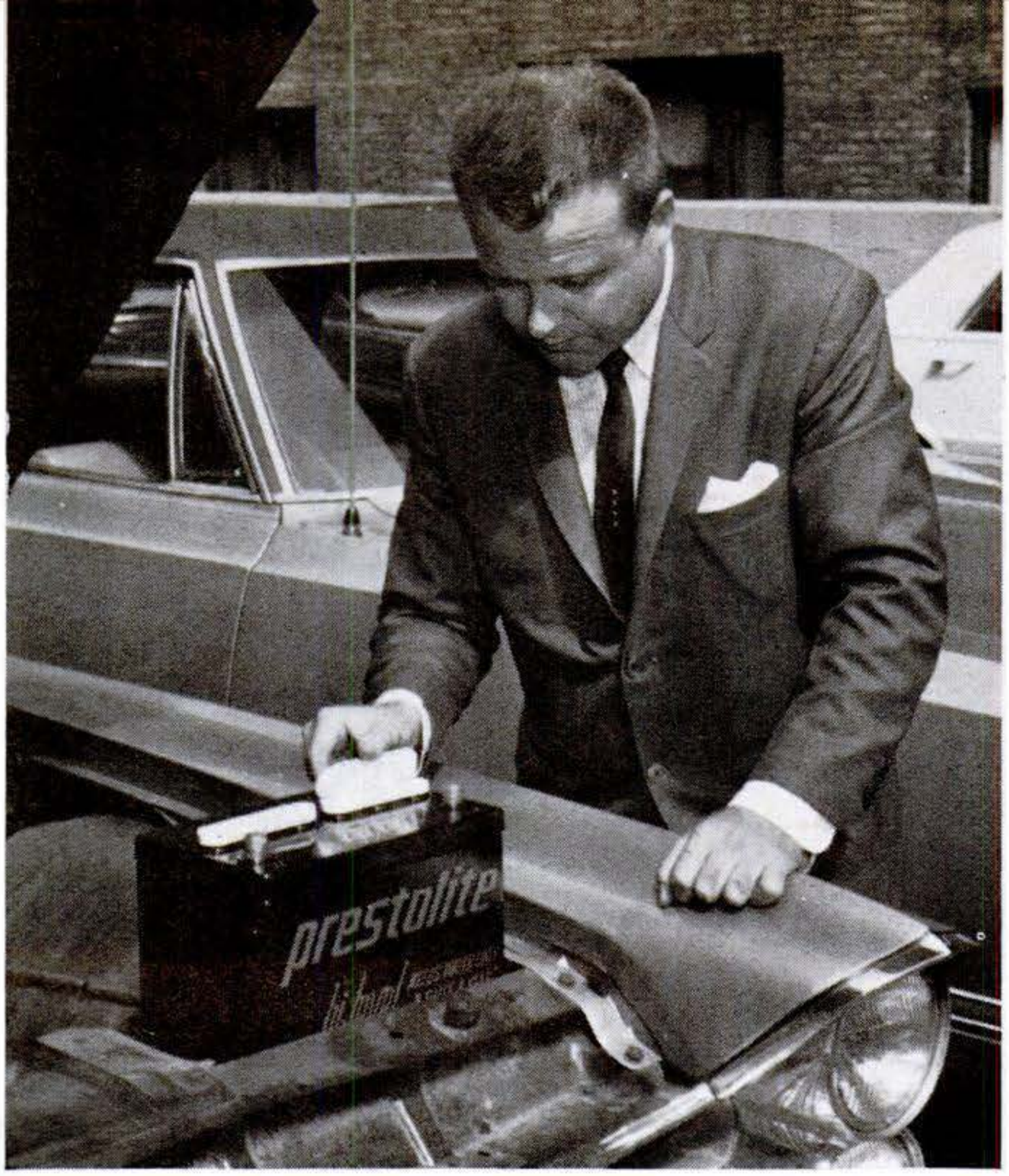
WHAT'S NEW

FOR YOUR CAR

Hinged vent cap speeds, simplifies battery service

Prestolite's new flip-cap covers three cells, giving easy access for inspection and service. No unscrewing is needed—the cap flips open at a finger-touch. It's securely attached, so there's no risk of losing vent caps. An arrangement of vent holes in the lid and concentric baffles under the lid reduces acid-spewing problems. Not an accessory, the cap is part of all new batteries. Prestolite, Toledo, Ohio 43601.



Sears radial tires raise gas mileage, improve steering

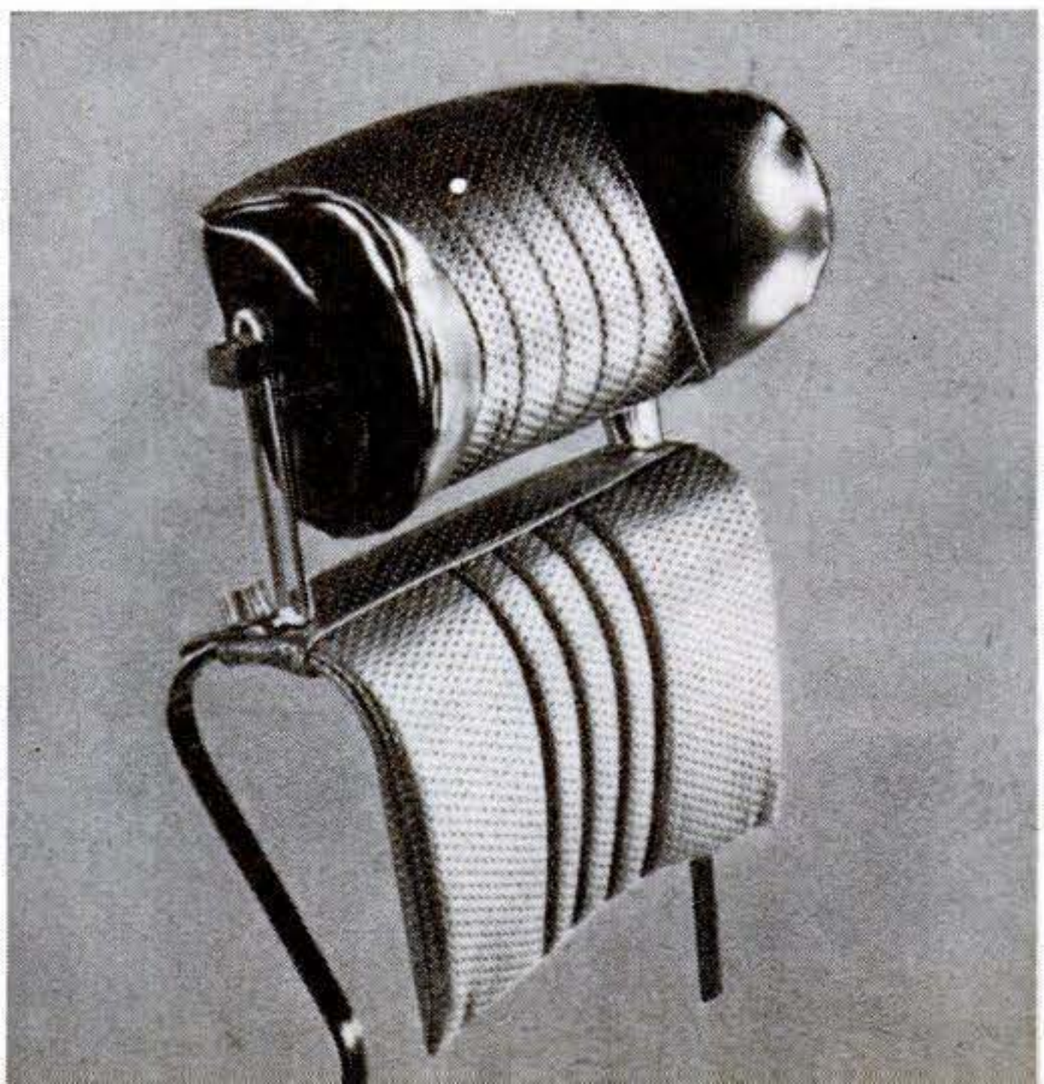
You can double your tire life, says Sears, Roebuck, with this new tire, available in three sizes for 14- and 15-inch wheels. Also claimed: improved traction in all weather, more accurate steering, improved fuel economy by eight to 15 percent. Two bands of fine steel cords strengthen the tread, and carcass plies are laid radially bead-to-bead instead of crisscrossing.

Washcloth made of synthetic leather

The washcloth below (left) wrings out three times its weight in water, holds twice as much water as an ordinary cloth (right). Secret of the Kar-Flik is synthetic leather, says the Pellon Corp., 1120 Sixth Ave., NYC 10036. It's also said to be unaffected by oil or solvents.

Contoured headrest will fit any car seat

This foam-padded headrest is supported on a sturdy plastic-covered steel frame that fits any seat, bench or bucket. Wingnuts give easy angle and height adjustments. It comes in black, red, white, and brown at $11, from J. C. Whitney, 1917 Archer Ave., Chicago 60616.



Just flip one simple lever into 'Jeep' 4-wheel drive.

A 'Jeep' Gladiator takes winter's ice and snow, slush and mud in stride. Just flip one simple lever into 4-wheel drive —at any speed—and you've got twice the traction going for you. Drifted snow, slush, ice, mud are all duck soup for 'Jeep' 4-wheel drive. You get more done, in less time, in almost any kind of weather. On the highway, it handles like a passenger car. Drives smoothly, comfortably and with twice the traction of ordinary 2-wheel drive pick-ups. See for yourself... give it a test drive today.

Equip your Gladiator to fit your needs: 250 hp V-8 engine or Hi-Torque 6; choice of colors; standard or custom cab and trim; full width or bucket seats; 7 or 8 foot box; power steering, power brakes, camper modifications available; pulling, winching, or plowing equipment; 3 or 4 speed transmission with standard shift, or Turbo Hydra-Matic* (the only pick-up offering automatic transmission with 4-wheel drive); GVW's 5000 to 8600 lbs.

*TRADEMARK GENERAL MOTORS CORPORATION

KAISER Jeep CORPORATION
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You've got to drive it to believe it. See your 'Jeep' dealer. Check the Yellow Pages.

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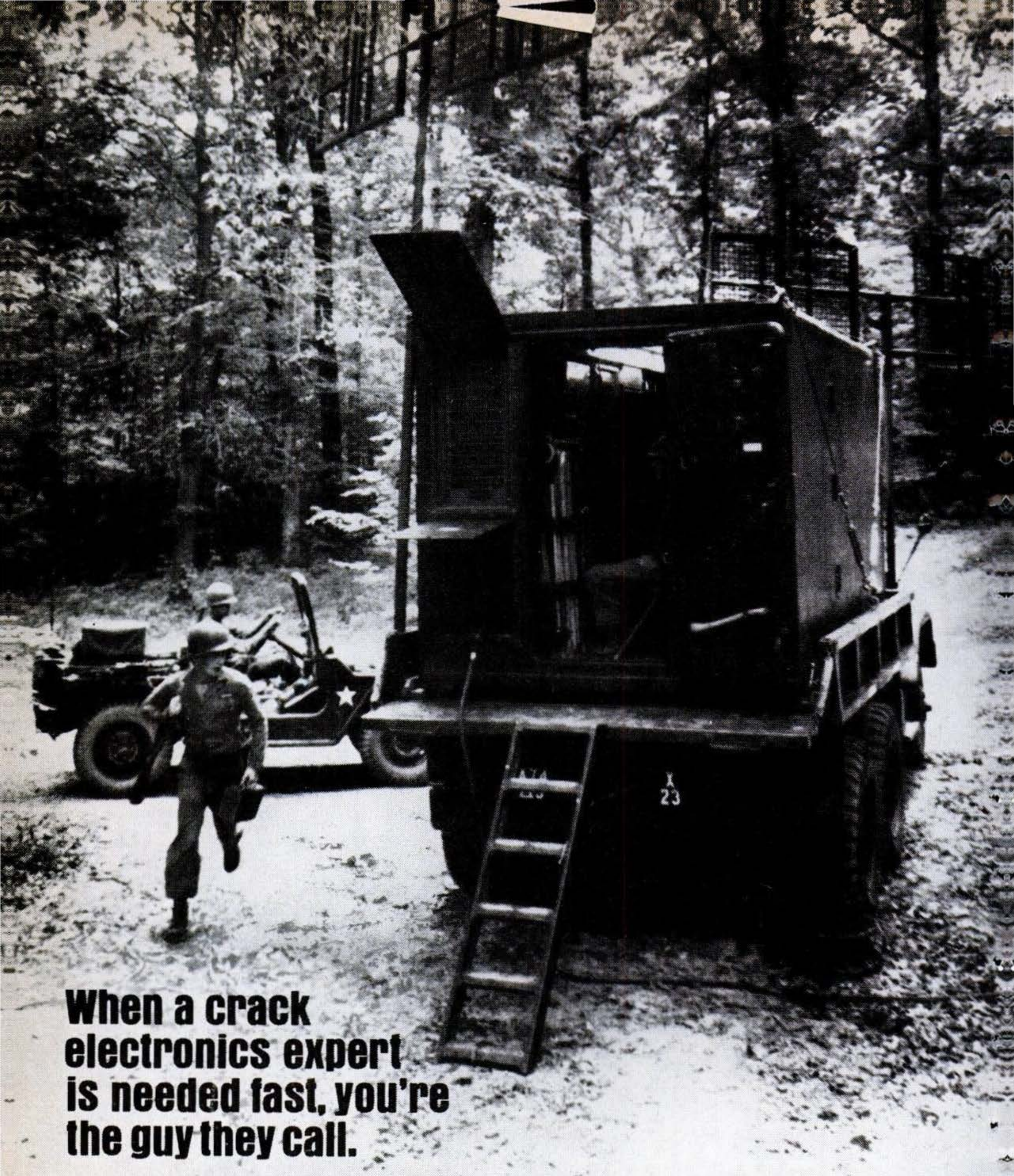

When a crack electronics expert is needed fast, you're the guy they call.

Sometimes you feel like a country doctor with sixteen cases of measles in town.

But working on emergencies is nothing new to you.

You're the expert and emergencies are your job.

You're the one guy in the company that can practically field strip a computer and put it back together again. Circuits are so pressed into your brain you can almost hear a short one. They make the TV's you repaired back in high school look like crystal sets.

If it wasn't for the electronic training you got in the Army, you'd still be a tube tester. But the Army opportunity came along and you took it.

A full-dress, eight-hours-a-day, five-days-a-week school that taught you a skill you'll build a career on.

A solid career that can mean sound security all your life.

There's nothing like being an expert. That's what you can be in today's action **Army**

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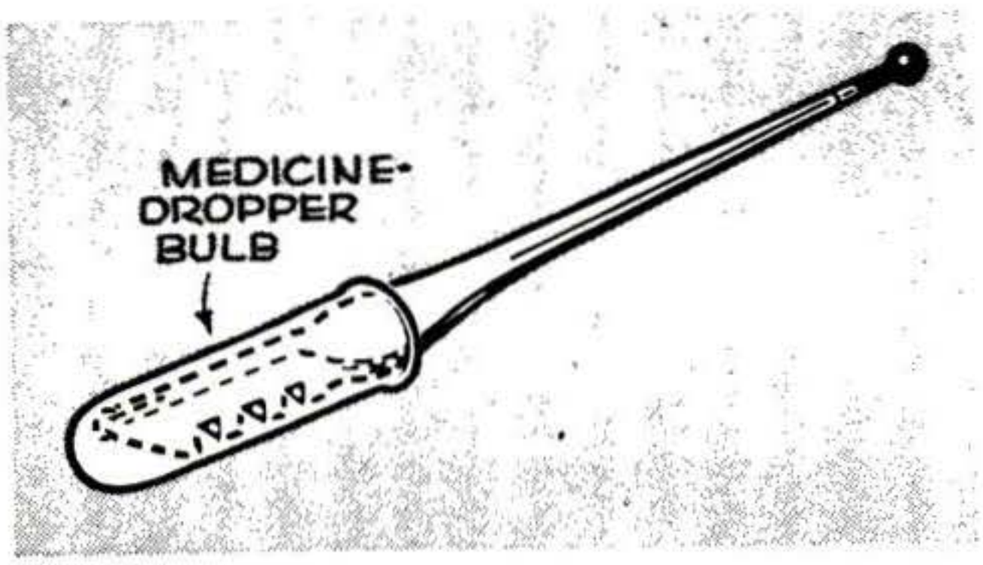
SHORT CUTS AND TIPS FROM PS READERS



Guard extends life of glass cutter

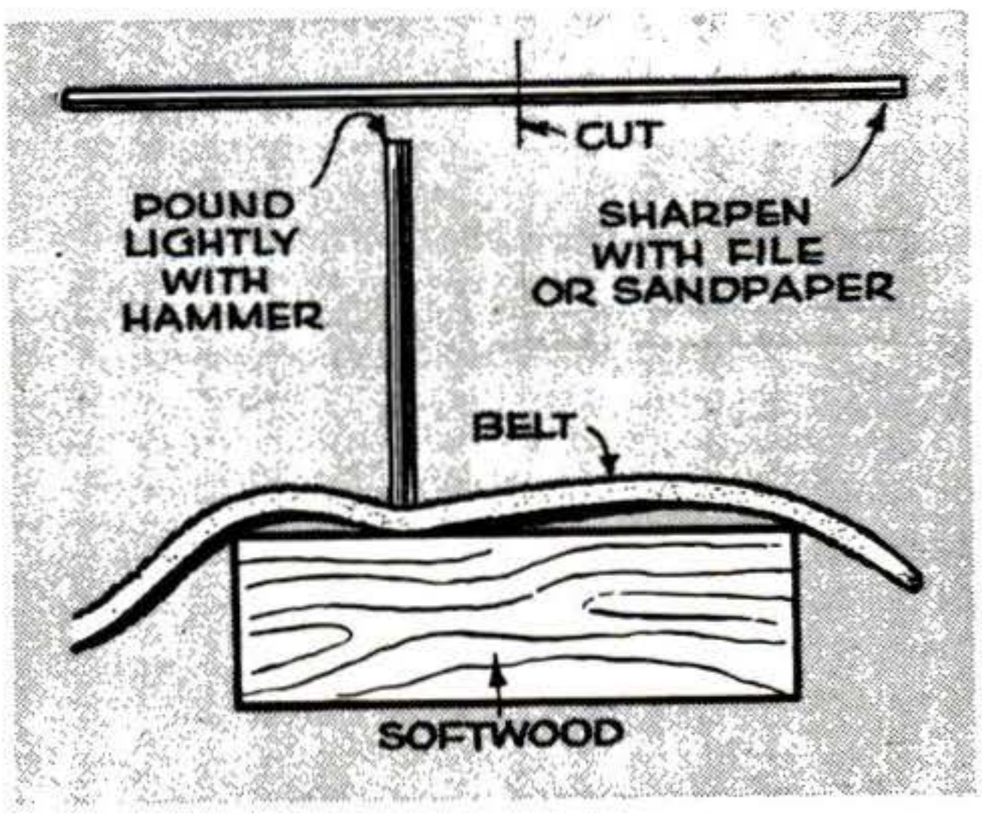
A rubber medicine-dropper bulb slipped over the end of a glass cutter when it is stored will protect the cutting wheel from being nicked or dulled by other tools.

DANIEL BOUSHA, Jackson, Mich.

Remove old laminates with a thinner

You can remove damaged laminates from tabletops by using lacquer thinner to dissolve the cement that binds them. Do the job outdoors, as the thinner is highly flammable. Use a plastic bottle to squirt the thinner down into the work while you wedge a sharp knife under the damaged layer. Apply plenty of thinner and keep a steady pull-away pressure on the laminate.

ELWIN TRUMP, Wymore, Neb.



Pen refill makes a leather punch

An empty brass cartridge from a ball-point pen, cut off and sharpened on the end, makes a light-duty leather punch. It is especially handy for making holes in a belt. Lay the leather on a block of soft wood and tap the punch lightly with a hammer.

CARLE E. WIENINGER, Palo Alto, Calif.

How you can become an expert in today's action Army.

Your first step should be towards your Army Recruiting Sergeant. He has all the facts on more than 300 courses open to you. You'll get the course you select guaranteed in writing *before* you enlist. And there's no obligation until you enlist.

Call him today. He's in the phone book listed under U.S. Government.

Meantime, get a colorful, exciting 40-page booklet about Army life and Army opportunities. Simply fill out and mail this coupon. There's no obligation.

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Please rush me your 40-page booklet, "The Secret of Getting Ahead."

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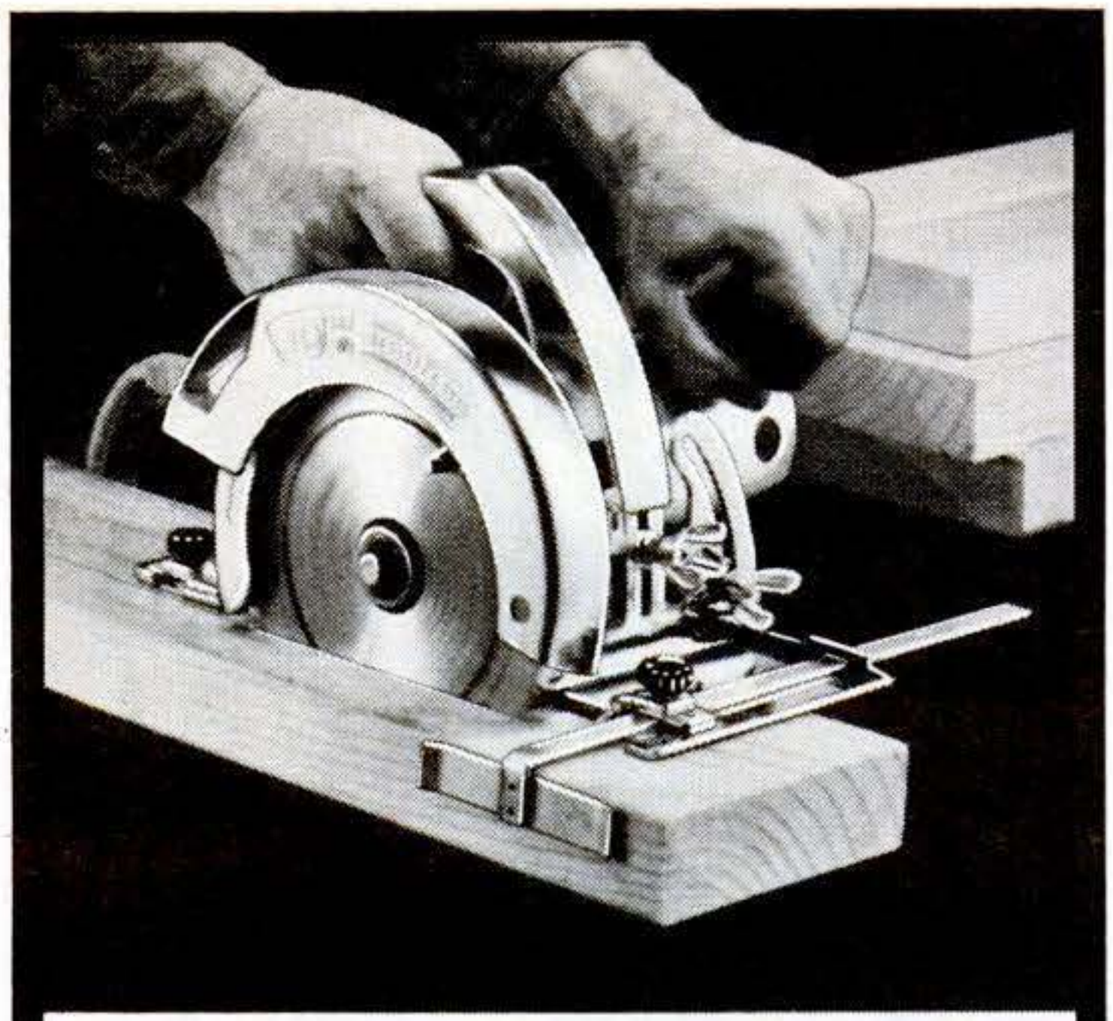


SOME THINGS ARE IMPOSSIBLE

. . . and right now it's impossible to buy a superior saw! The Wen Model 1000 Contractor's circular saw simply outperforms the competition and does it with safety, balance and precision. Loaded with power, it's loaded with features: 12 amp motor with burnout proof armature puts out 2½ H.P. running on all frictionless ball and needle bearings, depth and angle adjustments up front (even down to zero), rigid steel angle quadrant and heavy cast aluminum depth quadrant. You may prefer the 1000's companion model for homeowners—the Wen Model 960. In any event, compare price, value, performance of these circular saws with other brands, then . . .

just say WEN

100% AMERICAN MADE

WEN PRODUCTS
5810 Northwest Highway • Chicago, Illinois 60631

Antiseize compound protects threads

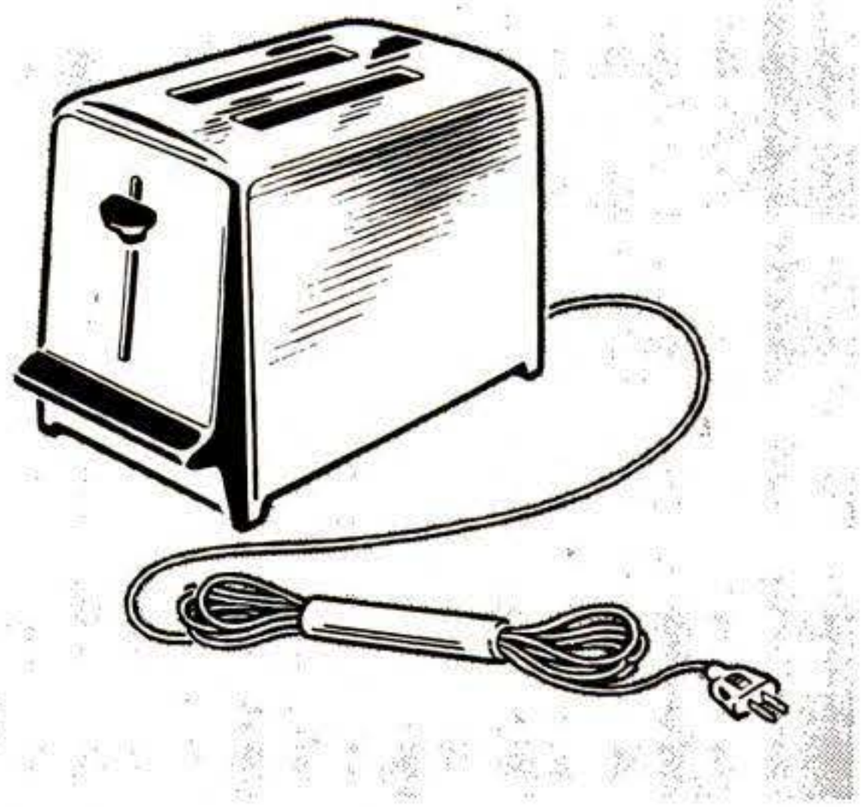
Protect nuts and bolts from rust by coating threads with antiseize compound before you assemble them. This precaution makes disassembly easy should the need arise.

CHARLES E. COHN, Clarendon Hills, Ill.

Hand-start drill to prevent skidding

Here's an easy way to start holes in ceramic tile without using guides to eliminate drill skidding. Put the bit in an electric drill and twist the chuck about 10 turns by hand before starting the drill. Drill files at low r.p.m.

L. E. DOUGLAS, Altoona, Pa.



Golf tubes keep electric cords neat

Cut a section of plastic tubing of the kind used to protect golf clubs, and slip it over looped appliance and extension cords.

R. L. TUPPER, New Britain, Conn.

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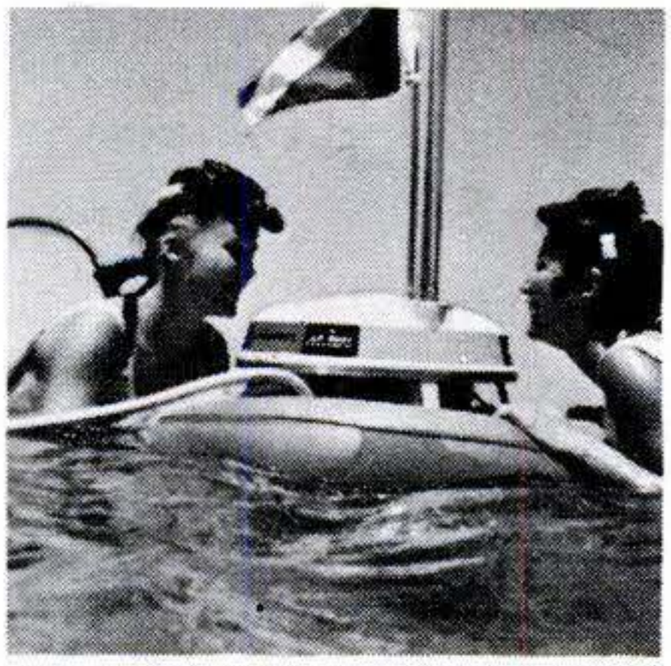
what sends you?

The quietest, fuel-savingest Sea-Horse motors yet (18 of them) plus the story of revolutionary Power/Pulse ignition?

New Johnson Sea-Foil boats, including the daring and darling Reveler — the next beautiful blonde in your life?



A guided tour of the fabulous world of skin diving, courtesy the Johnson Air-Buoy floating fresh-air station?

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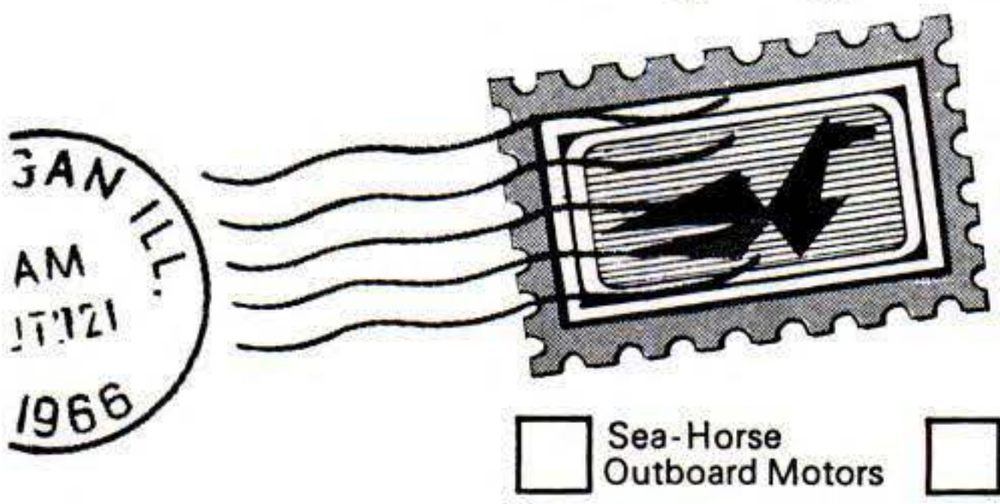

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A beautiful day to own a Volkswagen Station Wagon.

On Monday, January 24, 1966, an estimated 262,825,033.74 tons of snow fell upon the United States of America.

In Fraser, Colorado, a VW Station Wagon that stood for days out in temperatures of 25 below, started up without a tremble.

In Scarsdale, a lonely VW was blazing a trail to the commuter station.

In Albany, a VW took 8 angry neighbors down to the local service station for 8 sets of chains.

In Moline, a VW woman was first in line at the A&P Steak Sale.

Up in Boston, a group of college kids were finding out how many toboggans they could stuff into 170 cubic feet of VW space.

A Milwaukee junior hockey team showed up at the rink only to win by default.

On Monday, January 24, 1966, not too many VWs were sold in the U.S.A.

On Tuesday, things picked up.

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How They're Producing the Wankel, Tomorrow's Auto Engine, Now

Cutting grooves for the side seals on the rotor is done on an ordinary facing lathe. Three triangular workpieces are clustered on a circular fixture with their apexes meeting in the center. Twin tools cut one pair of grooves in each rotor at the same time. The rotors have to be positioned three times; they are then turned around and the sequence is repeated on the other flanks. This operation is highly accurate but time-consuming. Machining operation alone takes 24 minutes (18 different settings are called for).

You may be driving a car with a rotating combustion engine sooner than you think. Here's how NSU developed the strange tools it took to lick the production problems

By DAVID SCOTT / *PS European Editor*

While Detroit is sparking to the rotating combustion engine—with the Curtiss-Wright RC2-60 185-hp. prototype showing the way [PS, Apr. '66]—NSU in Germany is already tooling up for the world's first mass production of the exciting Wankel. As pioneer of this revolutionary power plant, and holder of all rights to the Wankel engine (C-W and 15 other companies in Europe

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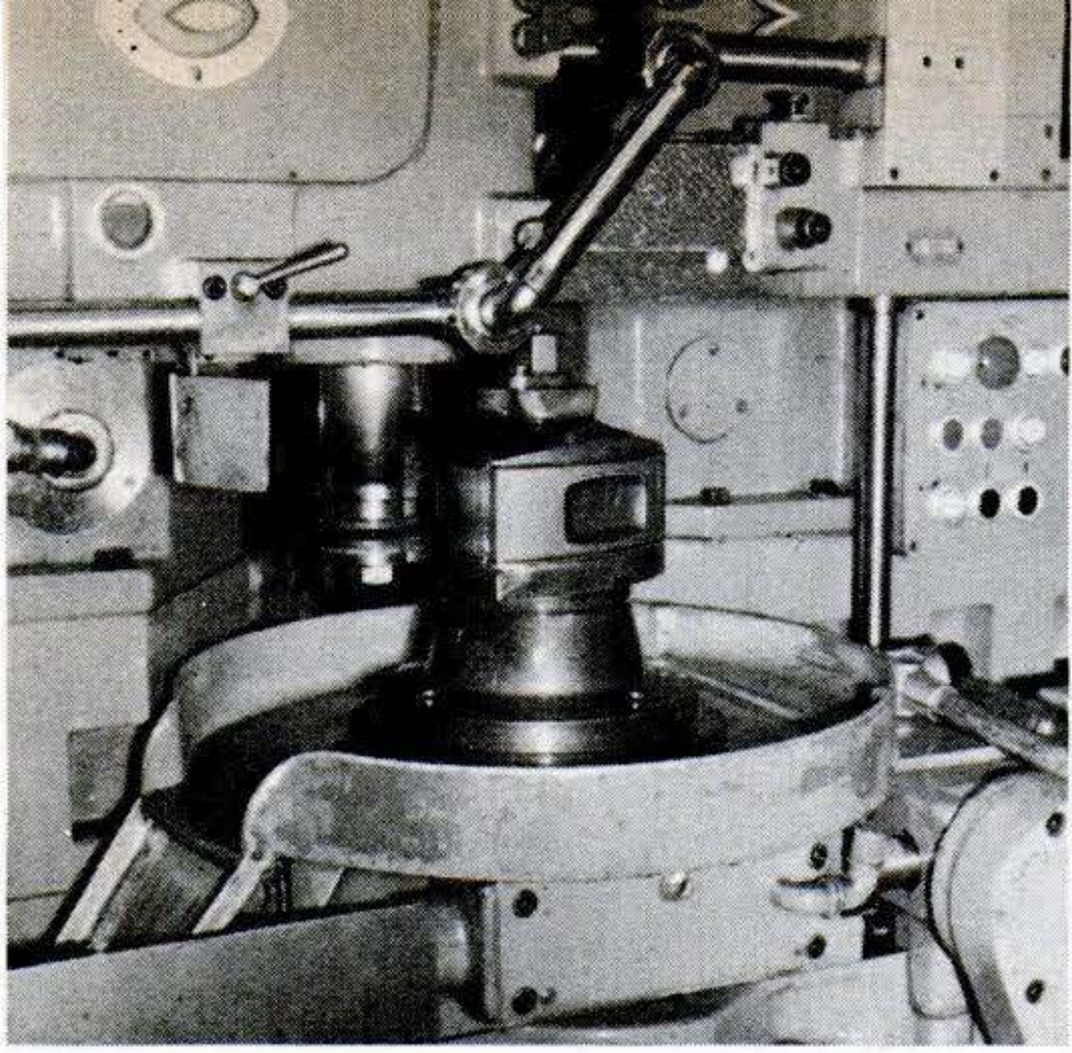
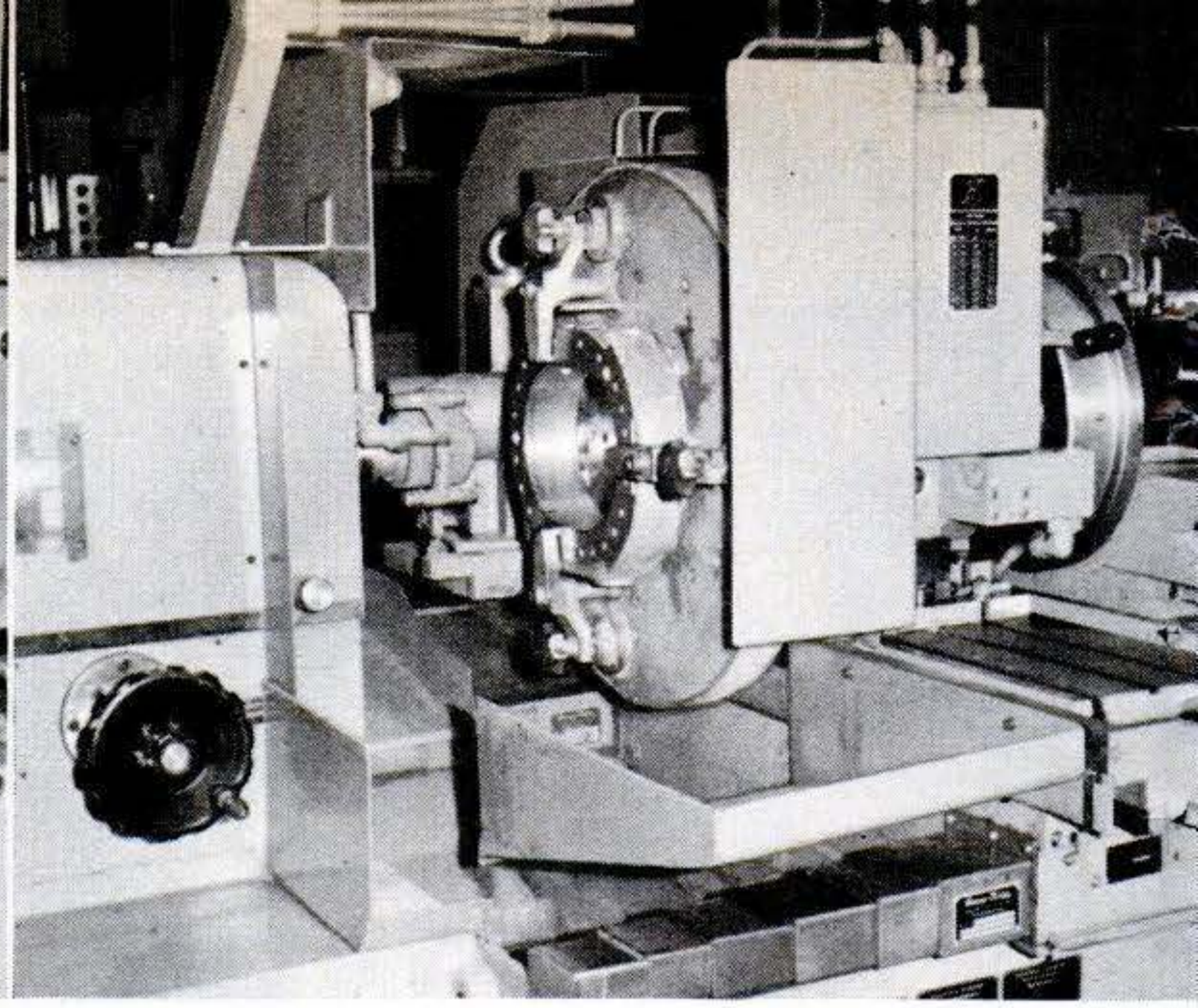


Curved rotor faces, with combustion chambers in relief, are machined on a standard gear shaper adapted for copying. A master cam gives the correct profile. The vertical toolbar runs up and down across the surface, and the rotor is turned slightly after each downstroke. Since the curved face is not a segment, it cannot be turned on an ordinary lathe. The complete cycle takes 20 minutes, so NSU engineers are now intensively trying to develop a faster copy-milling machine to do the job.



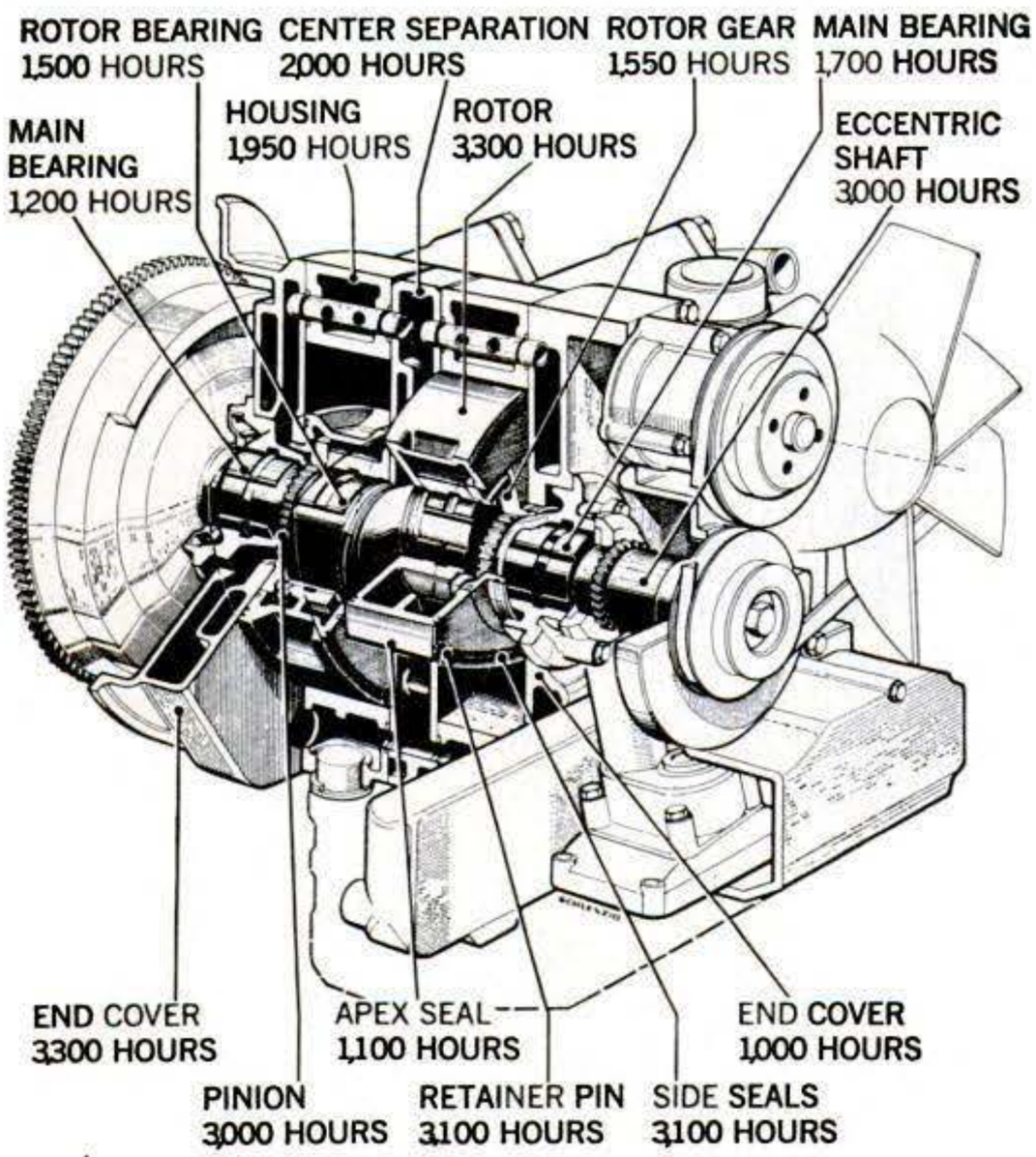
After turning, the trochoidal track is chrome-plated and precision-ground to a mirror finish on a hydraulic copying machine. Like other tools invented for the Wankel engine, it follows a sophisticated automatic cycle that trues or dresses the grinding wheel three times between consecutive feeds to assure precise contouring. Turning speed is 10 r.p.m. average—variations are made to correct for differences in the trochoidal radius and give the machine constant speed at the surface.

and Japan make it under licensing agreements), NSU has a clear lead in its special manufacturing techniques.

The Wankel engine has no cylinders and no pistons—in fact, no working parts in common with an automotive piston engine. [For a recap on the insides of a Wankel engine, see the cutaway drawing below. For its operating principles, go back to the April '66 issue of POPULAR SCIENCE.]

As you would expect, making Wankel engines calls for completely different tools. The tool designers at NSU are faced with no less severe problems than the test and development engineers. Two machines were necessary for the design of both the engine and the tools to make it:

1) A three-dimensional drafting machine for outlining all possible combinations of rotor and housing shapes and sizes. This



How well does a Wankel engine wear?

The single-rotor NSU Wankel engine has been in production since 1964. The twin-rotor engine in the drawing at left is still under development, but I was shown the results of durability tests when I visited the factory. The figures given in hours indicate time on a test rig before failure occurred in a part. A number of engines were tested at 85 percent of full load at various speeds up to 5,000 r.p.m. The figures given are averages for these test engines.

Today, NSU builds about a dozen single-rotor engines a day, and more than 1,000 cars equipped with this Wankel engine will be delivered in 1966. By the time another year rolls around, NSU will introduce a car with the twin-rotor engine. The factory is tooling up for a production capacity of 150 Wankel-powered cars daily by the end of 1967.—*Jan P. Norbye.*

Now! PS lies flat on your bench or table . .

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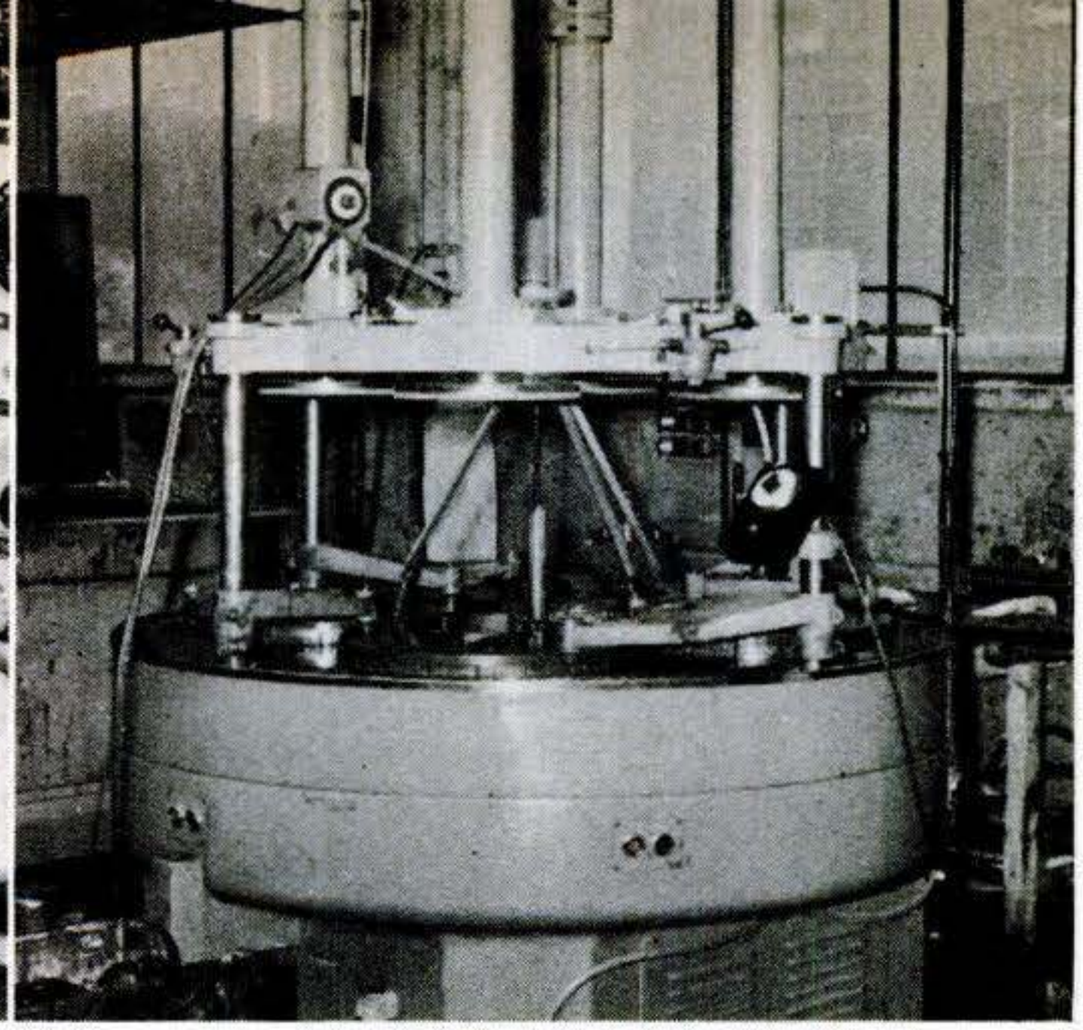
End covers are induction-hardened on a standard rotary machine. The heating element is a short, straight copper tube forming part of a high-frequency circuit fed from a 500-kilocycle 60-kilowatt oscillator. It's placed horizontally on top of the casting, heating a sector to a cherry red as the table rotates. Water spray quenches the area for instant hardening. The cycle is completed in one two-minute revolution, and then the castings are stress-relieved in a one-hour heating process.



Hardened end covers are superfinished on a modified lapping machine. Circular fixtures take four castings at a time, resting on a large "roundtable." The fixtures are free to revolve but are retained on "downstream" side by a pair of rollers contacting their rims. Upstream, fixtures are rotated by the wiping action of the table. An abrasive solution dribbles onto the table ahead of each fixture, and the combined turning and sliding laps in the surfaces. Four pieces take 40 minutes to complete.

one was built by Felix Wankel himself—the engine's inventor.

2) A semiautomatic drawing board to produce the correct epitrochoid (figure-eight shape with fat waistline that makes the housing's inner surface) for any given shaft eccentricity and rotor radius.

Two sticky production problems are well on the way to being solved:

- Cutting the side-seal grooves as shown on page 71 is a slow process. NSU is designing a new machine that will have synchronized, and possibly automated, indexing of the three rotors. Time will be cut from 24 minutes to six.
- Side-seal strips in today's production engines are fitted to individual length for prescribed end-clearance. This is necessary because the retainer-pin holes are bored on a two-spindle machine. NSU is developing a six-spindle double-ended boring machine that will drill all retainer-pin holes in one operation. All side seals will then be fully interchangeable.

Maintaining present high-precision machining and assembly standards in mass production is the next task ahead. NSU is determined to succeed, and is spending over $60,000 a month on research and development, plus the costs of road testing, pursuing electronic-measurement techniques, and expanding the tooling section. PS

Auto history is being made here, where skilled fitters are assembling 10 to 15 Wankel engines every day. This is a pilot line at NSU in Neckarsulm, Germany. Many of the machines in this shop, and in the machine shop in the background, plus some still under study, will be moved to a new building next year, when manufacture of the twin-rotor engine begins. NSU reckons that net tooling cost for a Wankel rotating combustion engine could be one-third that of a piston engine of comparable power.

. . . New "Perfect Binding" makes easy reading

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Great Old Cars Never Die...

they show up at meets every summer weekend while big crowds watch them compete

The antique- and classic-car movement is growing. At New Hope, Pa., last August, the famous Bugatti cars competed in a class of their own for the first time. Ettore Bugatti was an Italian genius who manufactured cars in Molsheim, France.

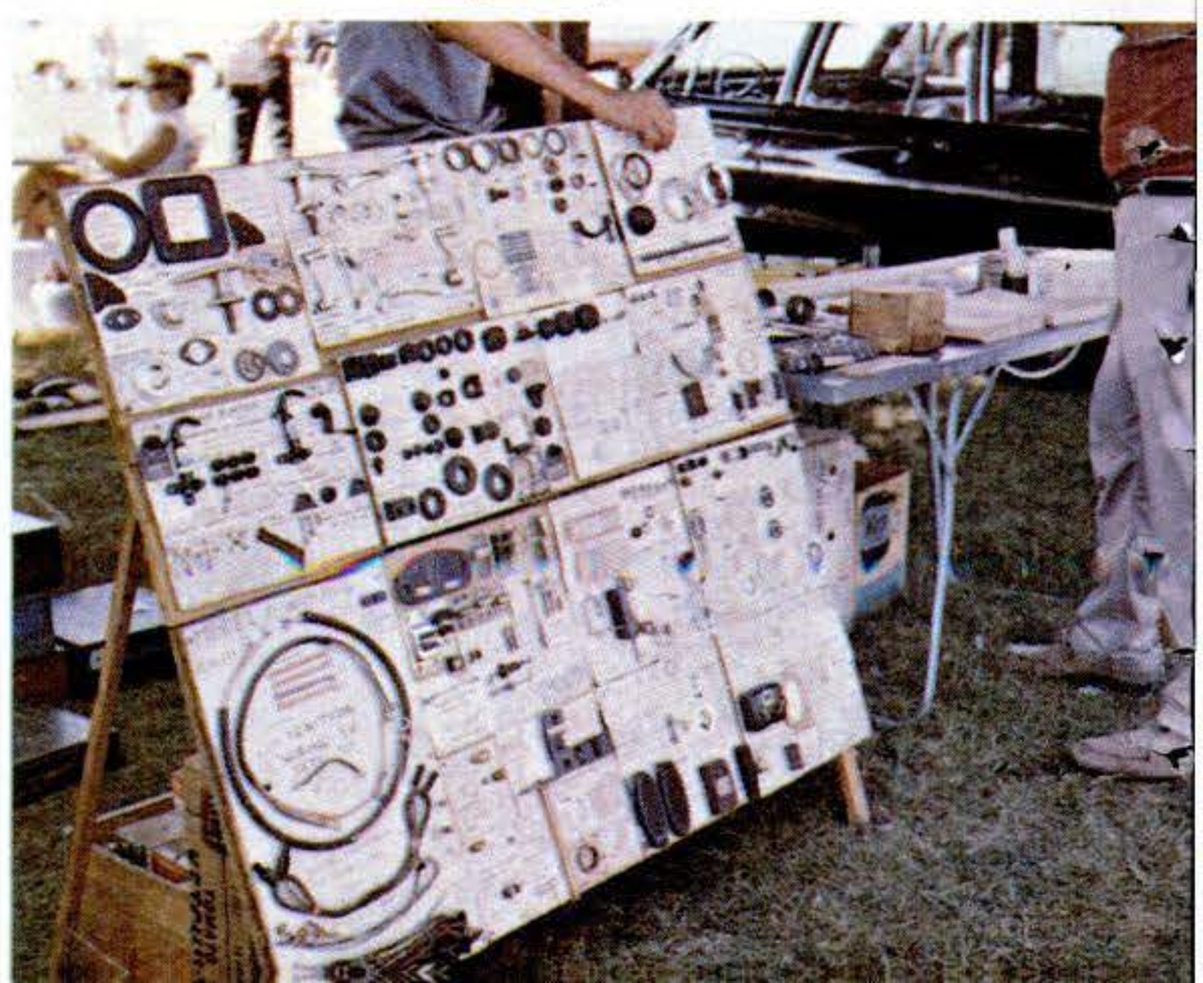
It was the ninth anniversary of the New Hope Auto Show; more than 200 cars were on display and some 12,000 spectators showed up to admire the cars, reminisce, and shop among the busy "flea-market" traders. Over 25,000 antique and classic cars are now registered in the United States, and new finds are still made all over the country.

The owner of this MG and his family apply some last-minute spit-and-polish before judgment.

A true classic, this 1939 La Salle epitomizes the styling trends of the late Thirties.

1909 Buick Runabout is typical of the medium-price cars of its era. It has been immaculately restored.

"Flea market" for owners looking for parts no longer made is found in many antique-car meets.

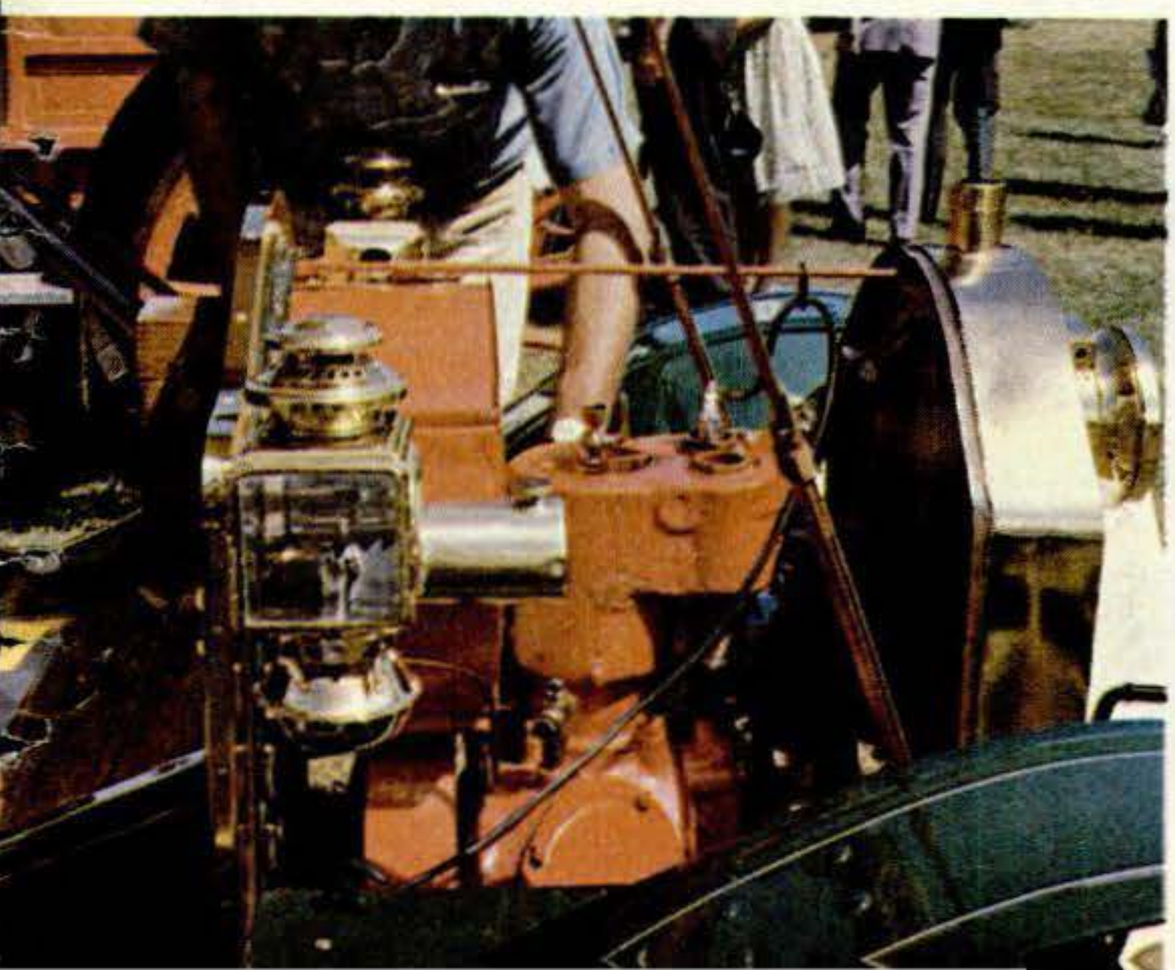


Prizes in the Bugatti class were presented by former Bugatti racing driver René Dreyfus.

Coffin-nose front-drive Cord has sparked one of the most active of the one-make classic-car clubs.

A supercharged 1936 Auburn Speedster is always a sure prizewinner, no matter what the competition.

1907 Brush had coil-spring front suspension. The shiny headlights seem almost *too* authentic.



Remember the Motometer? The instrument sat on top of the radiator and showed coolant temperature.

Here's Steve McQueen in the role he likes best—as one of the world's most skilled motorcycle riders. The popular movie star selected a group of bikes to test for POPULAR SCIENCE, then scrambled, jumped, and raced them on a sun-baked desert to see how much they'd take. Here's his story—plus tips on how to get more fun out of your own bike riding.

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MOTORCYCLES: What I Like in a Bike —and Why

By STEVE McQUEEN

First of all, I don't set myself up as an expert on either setting up machinery for racing, or in the actual sport of racing itself. But after 2½ years of desert riding in Southern California, TT Scrambles, Hare and Hound, and a bit of racing in the wet in the Six Day Trials in East Germany in 1964, I sure hope I picked up a little about motorcycles and riding along the way. It hasn't hurt, either, being partners with Bud and Dave Ekins in a motorcycle shop in the San Fernando Valley. That's been a keen education—like going to school. Dave won two gold medals, and Bud picked up three representing our country in the Six Day Trials, and they are two of the best desert bike riders this country has ever produced.

I was very pleased and flattered to be chosen to test six dirt bikes for PS.

Let's get to the point immediately. We assembled all the bikes on a scrambling course of six-mile perimeter, which had just about every type of terrain I could think of: cow trailing with a top end close to 70 m.p.h.; a sand wash with some rocks (to be avoided at all costs); sand dips of the washboard type with a depth of two feet maximum; several high-speed jumps of the TT variety; and a lot of fast trailing with quick changes, both up and down and side to side.

Here are my impressions of the bikes and how I rate them for desert riding—the kind of riding I'm mainly interested in.

The BSA Hornet. The first bike I tested—the BSA Hornet—is designed for desert riding or scrambles. It has a powerful 650cc engine and a damn good air cleaner—real important for hard riding or in the desert. It's important for the longevity of the engine because you don't have to take the carburetor apart to get the slide unstuck from sand and grit, a problem they don't have in the East.

It's a keen bike. But I found it awfully heavy. A lot of weight would have to be stripped off to make the bike competitive. (I prefer a lighter bike, which seems to adjust to the driver. It almost seems to become part of you in the test.)

The Hornet also had a tendency to want to go its own way. I always had to stay on top of it. But it sure had a good-functioning power train. I also think the front forks should be raked on a more forward angle. With this adjustment, the BSA would have a more stable ride in the rough and would be generally a smoother performer.

The Norton-Metisse. This is a TT bike with trials tires and no knobby (treads). It's a 750cc, four-stroke, two-cylinder that has lots of torque. With its Harmon and Collins camshaft and two Amal Monobloc carburetors, it

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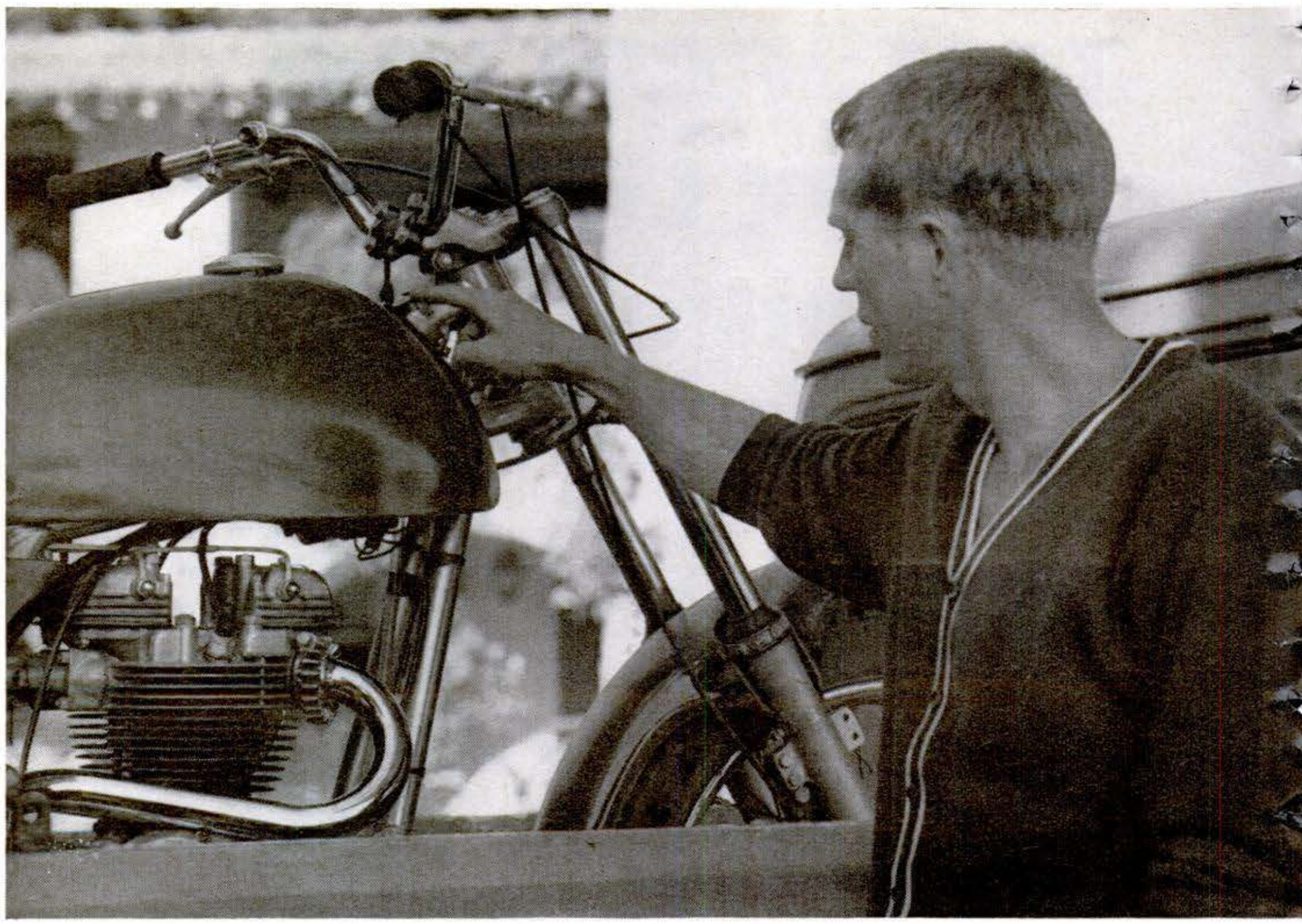
McQueen built his own bike, combining a powerful engine with a



Steve McQueen points to the oil intake of his Rickman-Metisse frame, which forms the basis of the new bike he built himself. The high-riding actor says that the frame is a great step forward in bike design because the whole frame is the "oil tank." The oil is exposed to a larger surface and thus stays considerably cooler than if it were circulating from a conventional oil tank. Keeping the oil cool helps prevent breakdowns, should make piston seizures rare.

produces almost 60 horsepower at the rear wheels. It's a handful. This semicustom model isn't a true scrambler. It's more of a TT, or track racing bike, because of its shorter forks which give you less ground clearance than I like a scrambler to have. Norton's history in road racing is well known, but desert riding is a bit different. You need the torque, but you also need the handling. I would say that you need at least 6½ inches of travel in the fork and stiffer shocks, but it's sure a goer. And it's very forgiving.

The Triumph Bonneville. My feeling has been that the Triumph Bonneville 650cc has been best for the desert until recently, when the lightweights started to nip at its tail. It has more wins in desert racing than any other bike. It, too, is of the brute variety. I found its new unit construction to be quite an advance over the earlier separate engine and gearbox. The front end has a tendency to push, but then you adjust to that and have a very smooth ride, and the Triumph front forks are bloody good. I would think, next to the Ceriani forks, they are the best. Having two carburetors has always been questionable in my mind—just another cable that could snag, and not that much speed is involved. However, the Triumph is a very strong bike that handles very well. The extra inch of travel and additional raking of the forks produce a smoother ride than it has had up to now.

The geometry of the Bonneville's suspension is set up for oversteer, and it handles real good. Its weight is competitive. The electrical system can be somewhat unreliable, but once sorted out it usually stays sorted out. I'd like to see something to replace the present electrical unit, which has caused problems for me in the past.

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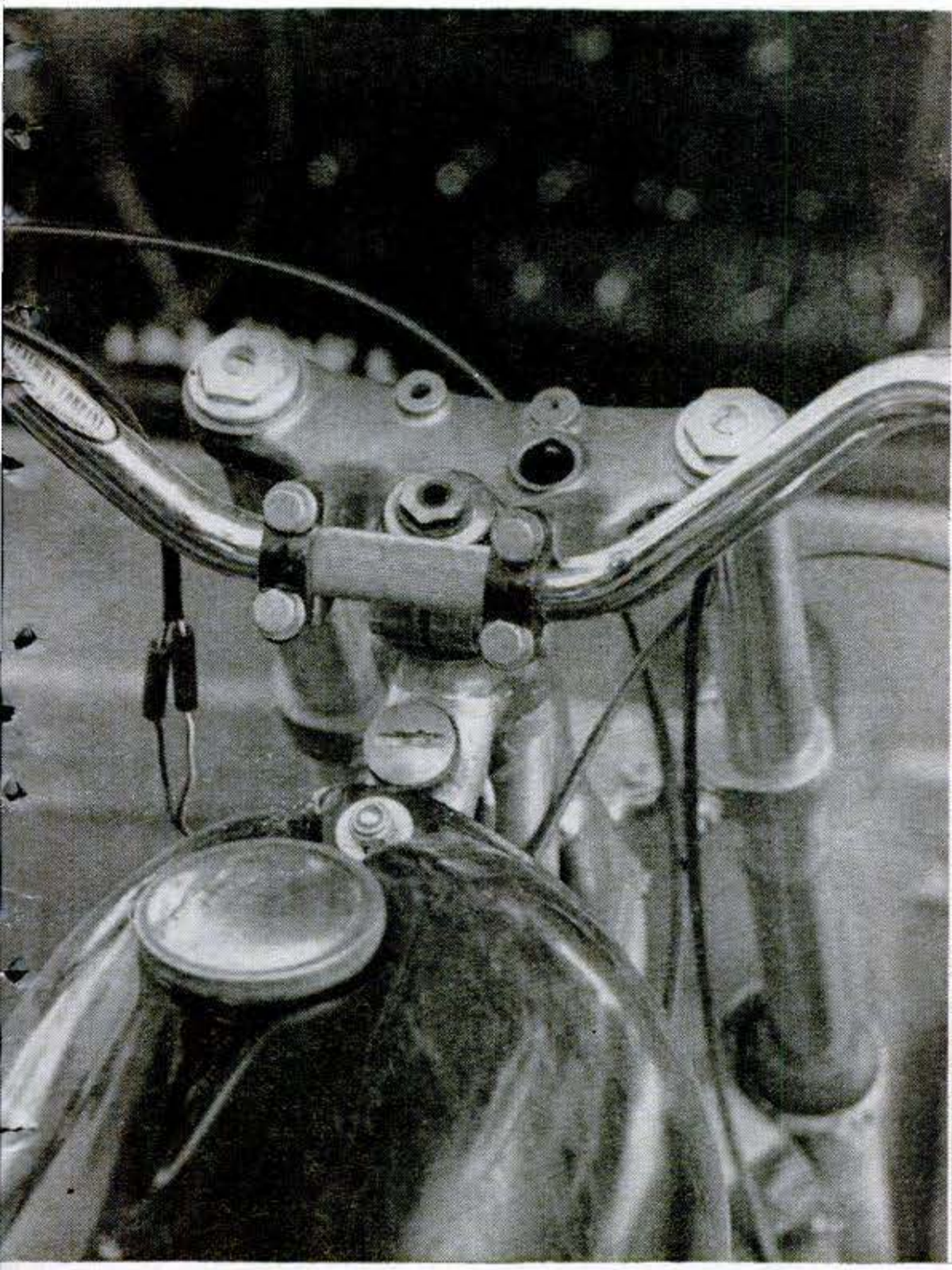
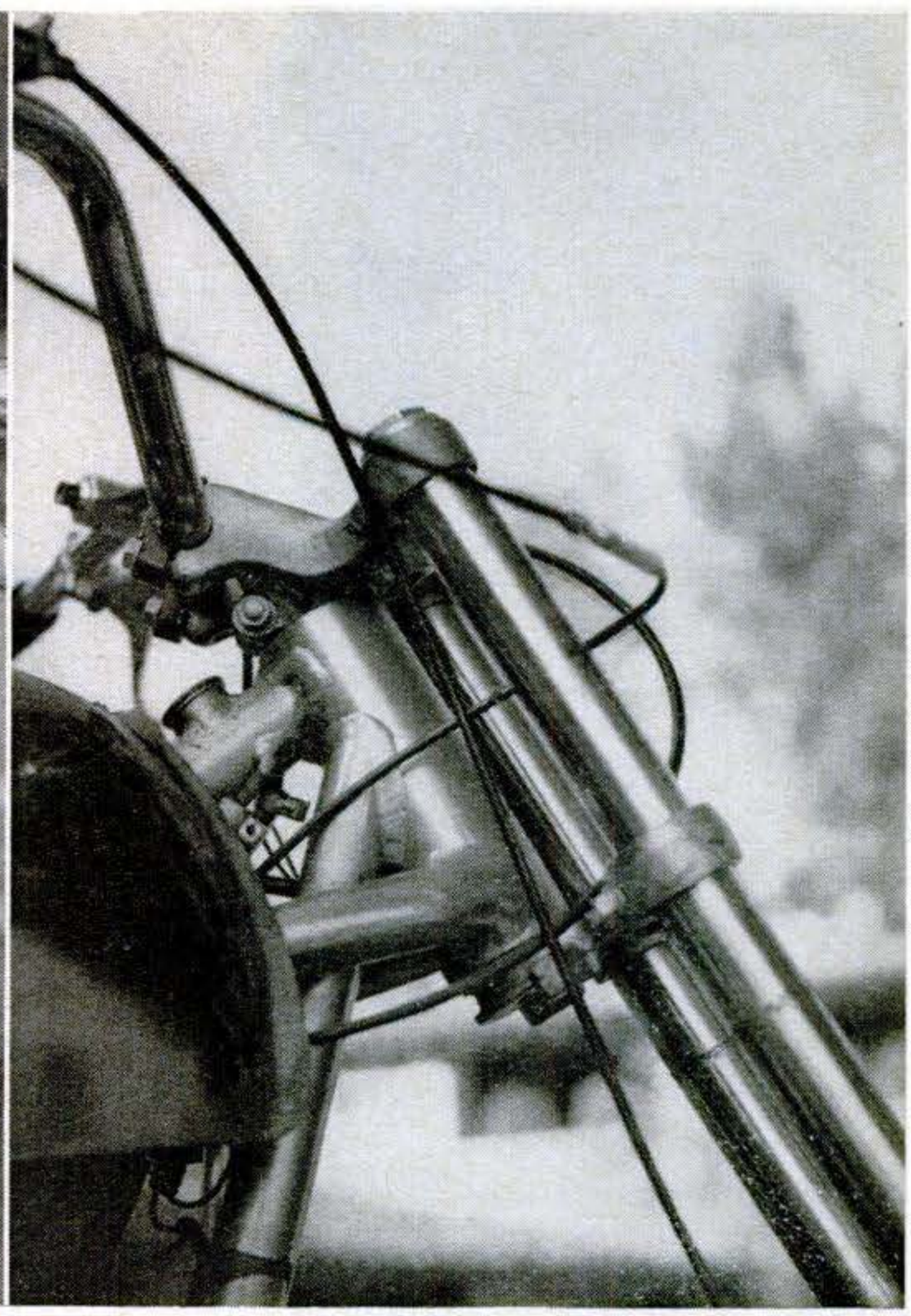
lightweight frame. The result, he says, is "like supersonic"



Components from various other bikes were added by McQueen to complete his Rickman-Metisse rig. The fork-crown above is from BSA, which is noted for making strong ones. "It's real important for me because I've hit bumps so hard sometimes that I've actually bent the handlebars," McQueen says.



Italian Ceriani forks help to give his home-built rig a smooth ride, McQueen says. They have 7½ inches of travel. This feature makes the rig more capable of taking the ruts and bumps typical of scrambling courses—the kind of terrain where McQueen prefers to do his riding.

The Honda. They have learned a great deal at Honda about desert riding. And they have set up the Honda Scrambler accordingly—good electrical system, super suspension, and a very good power train. They can be made to perform like a 500cc and you have a lot of r.p.m. to play with. It's a keen bike for the money.

The Greeves and Montesa. Despite my preference for four-strokes, I was surprised at the performance of these two-stroke bikes. The Montesa is a Spanish import with a 250cc engine. It's a great bike—a keen bike—and a comer. It has real good rear shocks with five adjustments and 6½ inches of travel in its front forks. The forks are very similar to the Ceriani, perhaps a bit stiffer.

The Montesa is a very neutral-handling bike with a light front end that can be brought up and down by turning it on full song in the

Continued

HOW THE BIKES STACK UP

MAKE	PRICE	WEIGHT (lb.)	DISPLACEMENT	STROKE	TRANSMISSION	START
BSA Hornet	$1,215	386	654 cc.	4	4-speed	Foot
Greeves-Challenger	$920	220	250 cc.	2	4-speed	Foot
Honda-450	$1,100	412	444 cc.	4	4-speed	Elec.
Montesa La Cross	$815	224	250 cc.	2	4-speed	Foot
Norton-Metisse	$2,000	315	750 cc.	4	4-speed	Foot
Triumph Bonneville TT Special	$1,274	350	650 cc.	4	4-speed	Foot
BMW R60	$1,288	440	600 cc.	4	4-speed	Foot
Harley-Davidson Sprint	$750	281	250 cc.	4	4-speed	Foot
Suzuki X6 Scrambler	$650	328	250 cc.	2	6-speed	Foot
Yamaha Catalina 250	$650	340	246 cc.	2	5-speed	Foot

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Two-stroke vs. four-stroke—here are the actor-cyclist's views on

Four-stroke Norton semicustom job, shown being revved up, has a 750cc engine. "It sure is a handful," McQueen says. "It's a race-bred bike with loads and loads of torque." But clearance is low.

Riding high on this 250cc. Montesa La Cross, the author finds it a very "forgiving" bike. "It handles just great," he says. This results mostly from neutral suspension. A Spanish import, it's a two-stroke.

first three gears, and it handles great. The high revs necessary for a two-stroke have been worked out very well. The revs just seem to keep going up and up. A couple of times I missed the corner. I was in fourth gear and honking right along. I was already sliding and too dedicated to change my line and just went flat out completely off the course. I expected to be up on the front end any minute doing a swordfight in the air with the handlebars, as there were some ruts and I was bouncing along pretty good. But the suspension took the punishment and I found it very easy to keep the weight going the way I wanted it—very forgiving indeed. It's an awful lot of bike for $800.

The Greeves Challenger is also a high-revving two-stroke that has been very successful in European scrambles, as well as in the desert. It's strictly a race-bred vehicle. A very healthy piece of machinery, it has even more beans than the Montesa. I've raced against them and they don't break down even in the hot baked desert air where a two-stroke is affected a lot more than a four-stroke.

These two-strokes have a lot going for

Capsule interview with Steve McQueen: "I like to ride flat out . . ."

"Boy, isn't it just great," Steve McQueen told me when he had finished testing these motorcycles for PS. (There were originally 10 in the group, but testing was not completed on the Suzuki X6 Scrambler, BMW R60, Harley-Davidson Sprint, and Yamaha Catalina because of technical difficulties and McQueen's tight schedule. Nevertheless, they are included in the chart on page 79, for your complete information.) Why does a movie star who just received $750,000 for making *The Sand Pebbles*, for 20th Century-Fox, spend his time cow trailing on a motorcycle? "It's the clean smell of the desert in the morning. The satisfaction of setting up a rig and having it work perfectly in every way," McQueen told me.

McQueen is happy about the popularity of motorbikes today. But he is a little concerned about new riders. "I think you have to learn to ride away from heavy traffic. Myself, I like to ride flat out, where it's allowed," he says. He urges motorcyclists not to take chances, though. Even though he reluctantly consented to pose for a few pictures without a helmet for PS, he urged motorcyclists not to ride without one. It can make all the difference between getting up from a crash and dusting yourself off—or having someone send you flowers in the hospital.

—*Herbert Shuldiner.*

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eir merits and handicaps, with a close look at some of each type

Greeves Challenger has "even more beans than the Montesa." This two-stroke, high-revving bike has been very successful in European scrambling competition because it's a healthy piece of machinery.

The BSA Hornet felt "awfully heavy." But then it has a great, powerful engine. The actor suggests that reduction of the bike's weight would make it a more competitive, more satisfactory vehicle.

them, but frankly I'm too attached to four-strokes to be completely won over. Despite the quality of the two-stroke engines, I still don't feel that I have all the torque I need to get out of trouble.

A hybrid bike. I prefer the big four-stroke engine, but on a light bike. The best way I've found to get this combination is with a bike I put together with the assistance of the Ekins brothers in our valley shop.

I used a Rickman-Metisse frame—a revolutionary piece of equipment that does away with the oil tank. The oil circulates through the tubes of the frame, which keeps it cool. That's especially important when you're racing or driving under hard conditions. It helps to avoid breakdowns and should make piston seizures quite rare.

I used a 650cc Triumph engine as a power plant for this bike. The drive train and gearbox are also Triumph. It has Ceriani forks with 7½ inches of travel for a real smooth ride, and a BSA crown. The fiberglass fenders and tank hold the weight down to a notch under 300 pounds.

The rig is the best-handling bike I've ever owned. And the power—it's like supersonic. You can build a rig just like it by ordering the frame from the Rickman-Metisse distributors in England. The frame costs $400 and you can scrounge any other components you need

Triumph is the bike that McQueen is most partial to. A desert champion, this Bonneville TT special has a 650cc, four-stroke engine that is one of the most powerful in the world. Unit construction is new.

to complete the bike from junkyards. You should be able to put together a real first-class bike for a very modest sum—and that makes plenty of sense.

Summing up, I'd say they're a high-performing group of bikes and I had a ball riding them. PS

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A strange new drug that stimulates the brain's production of RNA may raise your intelligence. Researchers have built a unique test game to find out

By W. STEVENSON BACON

Student volunteer attempts to learn intricate keyboard pattern with the help of drugs. Sharp tone in headphones indicates mistakes.

A pill that can actually make you smarter—able to learn more quickly and remember what you learn? It may happen. A drug, known as Cylert, that could lead to such a pill, is currently undergoing testing on a group of healthy, normal college students. But whether it works or not, a revolution is in the making.

For the first time, man is tinkering with the mechanisms of memory and learning ability. No longer content to leave the brain's development to nature, researchers are probing it and exploring its chemistry. Now they think they may know enough about it to improve its functioning. To find out more about what's going on, I recently visited the University of Michigan and volunteered to take part in the drug tests.

I was led into a tiny, windowless concrete-block room where I was seated at a table. The doctors left, and I waited nervously for the test to begin. Overhead near the ceiling, a closed-circuit TV camera glared down at me, and there was a hiss in the cushioned headphones strapped to my head. In front of me was a keyboard.

Just as I was wondering for the fiftieth time what had been in the small, multicolored capsule I had swallowed a couple of hours earlier, a voice came out of a small intercom: "We're ready to begin. There are eight lights on the panel in front of you, each of which can be turned off by one of the eight finger keys. Your task will be to learn which key turns off which light until you can control them without making errors."

Instantly a light shows on the panel in front of me; number seven counting from the right. "Well, I've got to start somewhere," I think to myself, and push the corresponding key, number seven. A harsh tone in the headphones indicates that I've made a mistake: Soon that sound begins to affect me like a ruler slapped across my knuckles.

"They're probably laughing at me," I think to myself, and I grimace at the TV camera. "I'll show them." I begin to concentrate, pressing the keys slowly and cau-

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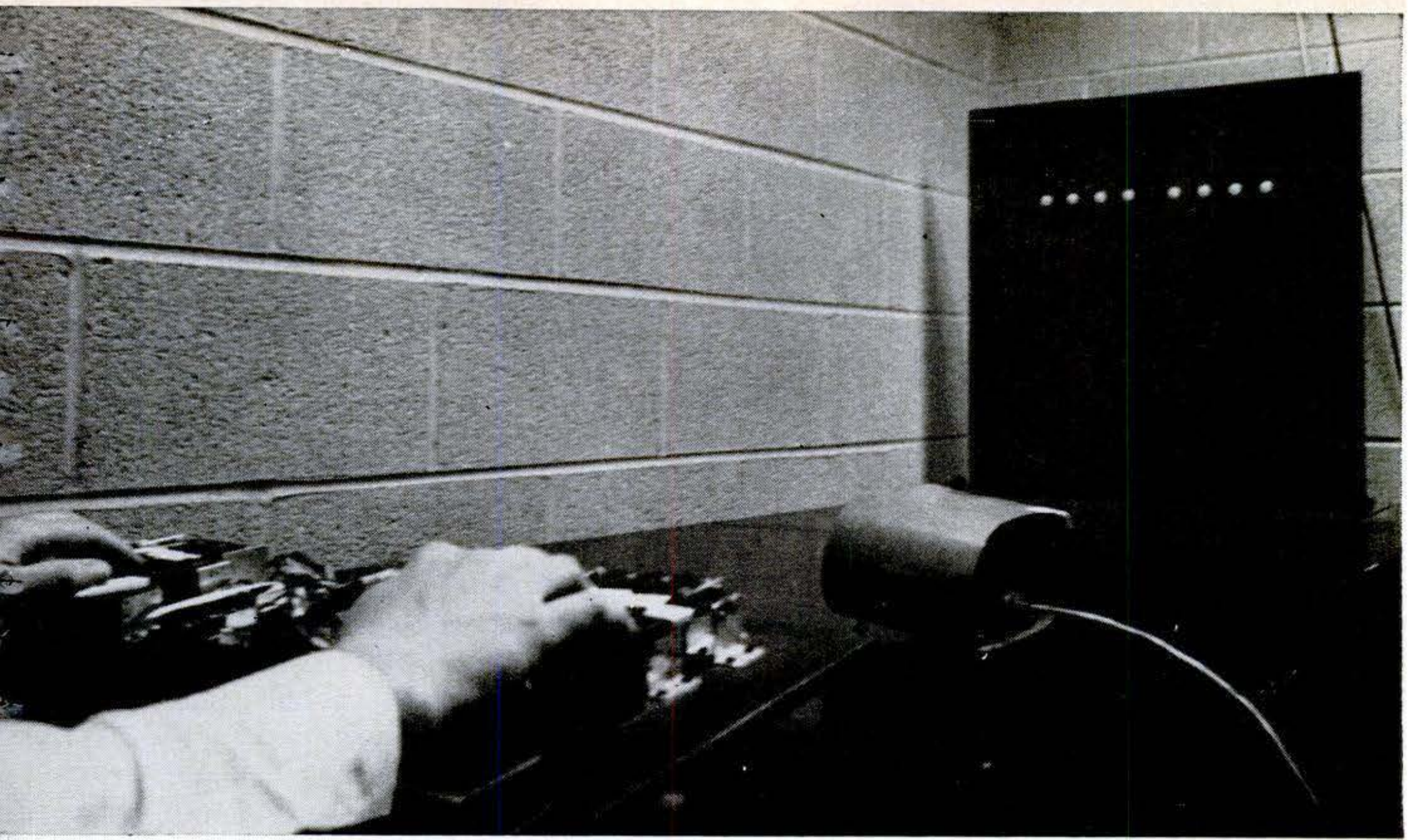

Eight keys, one for each finger (the thumb-rests are dummies), correspond to the eight lights mounted on board at right. Learning task is to find which keys control which lights and remember all eight.

tiously. Gradually my score begins to improve. Then I fall back, making errors. I shake my head, and beads of sweat roll off. "Darn," I mumble, loud enough for the intercom to hear. At last, almost an hour later, comes a long stretch without errors.

"You've got it—you've learned the pattern," says a voice from the intercom. "That will be all."

Dr. John Burns, experimental psychologist at the University of Michigan comes into the room. "You did pretty well," he says.

"By the way," I ask him, "what was in the pill I took?"

"Nothing," he smiles. "You're a member of our control group and got a placebo—a sugar pill."

If I had been in another group of volunteers in this revolutionary experiment, it might have been Cylert. The test—literally a "rat maze for people"—is designed to tell researchers whether or not Cylert really does make you smarter.

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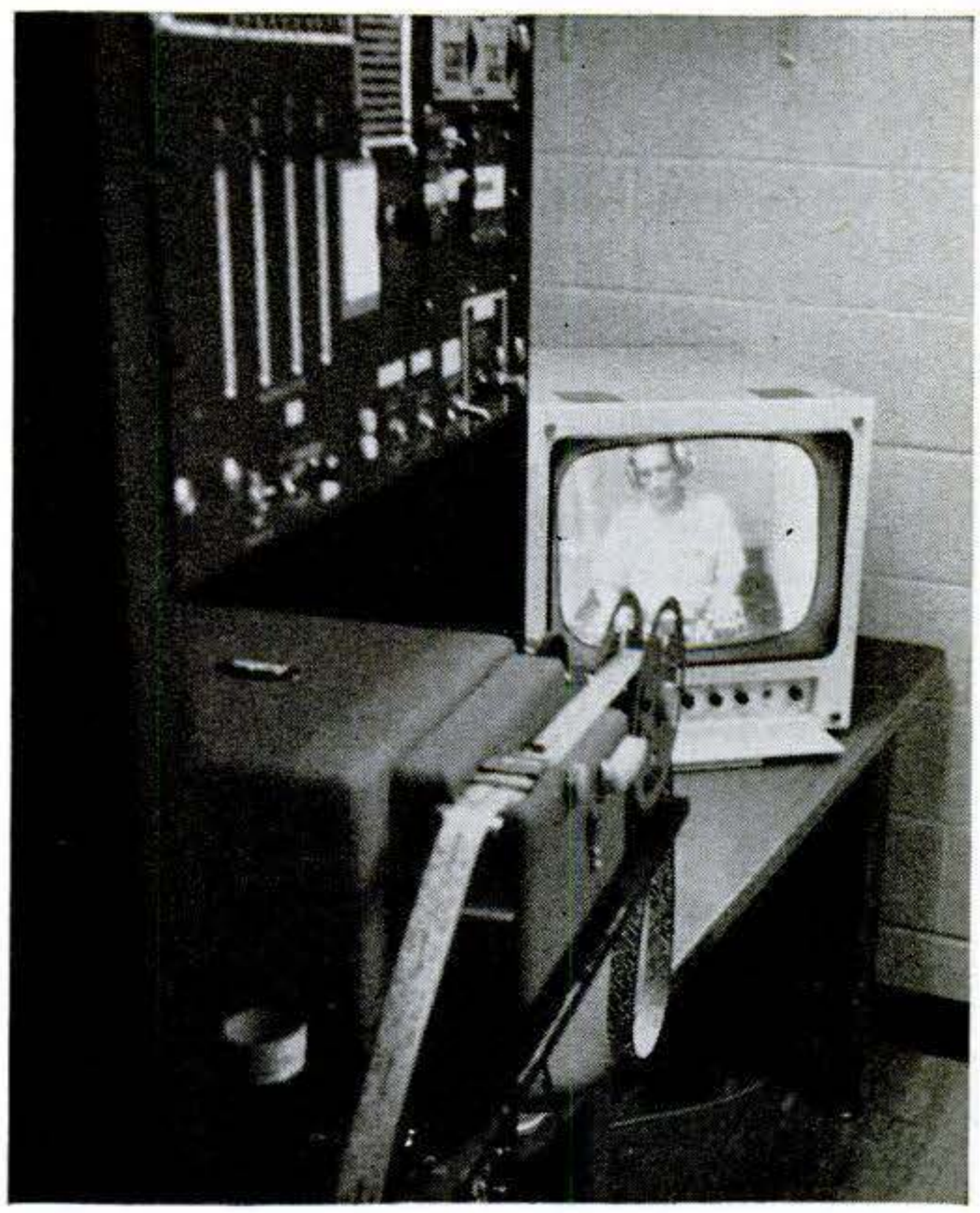

Taped program causes lights to glow randomly. Equipment records right and wrong answers, time required for response, other data. TV monitor lets researchers watch the actions of volunteers.

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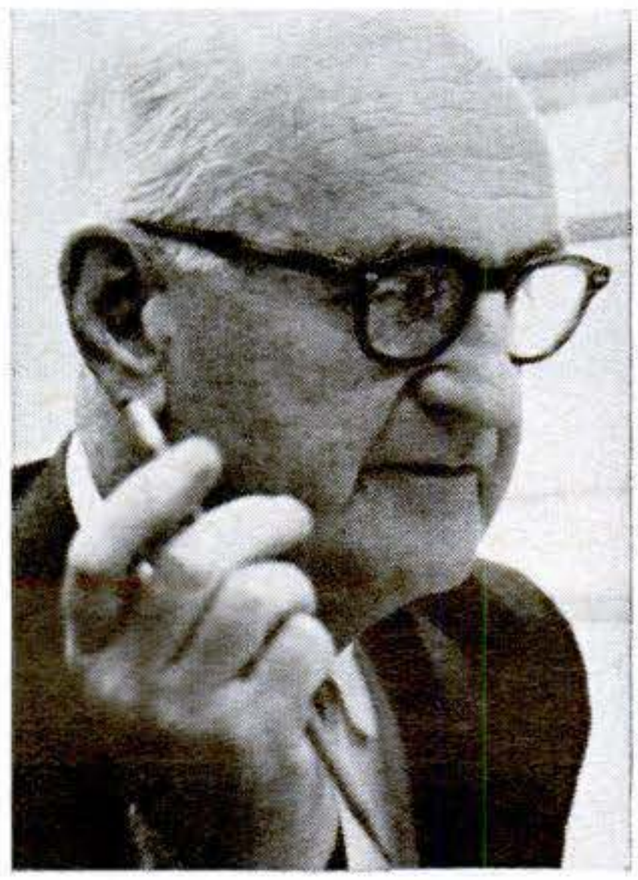
Drugs offer a "potent variable" in learning and memory, and ma

How it began. What is this peculiar drug? Basically, it's pemoline, a mild stimulant first synthesized in Germany in 1913, and available overseas since 1956. In itself, pemoline created no particular excitement. Then, in 1962, researchers mixed it with magnesium hydroxide and strange things began to happen.

The combination, labeled "Cylert" by Abbott Laboratories which manufactures it, causes the gray matter of the brain to churn, figuratively speaking, stimulating the production of the stuff of which scientists believe intelligence and memory are made: giant protein molecules of ribonucleic acid, or RNA.

Tests on animals with Cylert, by Dr. N. P. Plotnikoff, Abbott neuropharmacologist, reported last December, showed that rats given the chemical learned to escape shocks in an electrified cage four to five times faster than untreated rats, and remembered what they had learned.

At the University of Michigan, experimental psychologists Drs. John T. Burns and Robert F. House, working with the help of Dr. James G. Miller, Director of the Mental Health Research Institute, determined to repeat the tests—this time with humans.



Pioneer in the use of Cylert to help improve the memories of the aged, Dr. D. Ewen Cameron found evidence that the drug may be effective, and that it warrants further investigation.

The brain: a modern theory. Until quite recently, many biologists held that the human brain was very much like a computer; that the functioning of the neurons—in some ways the brain-cell equivalent of a computer flip-flop circuit—was essentially electrical in nature.

With this theory, a memory trace would be recorded in the form of a circulating electric current that would gradually weaken and disappear. The problem is that the theory is contradicted by experimental evidence: Severe electric shocks do not normally cause loss of memory; nor does freezing experimental animals below the point where the body's electrical activity stops, and then reviving them.

In 1960, powerful evidence for a molecular theory of memory and thought—coupled with a modified electrical theory to account for short-term memory—came from the experiments of Holgar Hyden, Swedish neurobiologist. Working with rabbits, Hyden and other researchers found that any kind of sensory stimulation—teaching the rabbits new tricks in order to get food, for example—resulted in increased production of RNA by the brain's neurons. Even more important, the RNA protein molecules produced were different chemically than any of the RNA found in untrained rabbits that were used as controls.

The implication was clear: The basic processes by which you think, learn, and remember are at least in part chemical—your brain records information by varying the composition of protein molecules of RNA.

Further evidence for an RNA-memory-learning link-up came from the well-known experiments of Dr. James V. McConnell who fed bits of trained planaria, or flatworms, to their untrained comrades. In a simple, but highly significant, experiment in 1962 he was able to show that learning could thus be transferred. Similar experiments with animals of higher orders have, however, produced dubious results to date.

As early as 1956, experiments in memory enhancement in elderly people were begun by Dr. D. Ewen Cameron and his colleagues at McGill University, who first tried administering deoxyribonucleic acid, or DNA. It seemed logical that these gigantic protein molecules—which are found in every body cell and carry the endless thousands of "instructions" that determine exactly how the body should develop—might also govern the complex memory and thought processes. DNA acts as the template or pattern for producing RNA.

Although Cameron found no significant changes in his patients when they were given DNA, RNA (derived from yeast)

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dically improve them

seemed to produce at least temporary improvements in memory. But a much better approach to the problem might be to find some way to stimulate the brain's *own* production of RNA. So thought biochemists Alvin J. Glasky and Lionel N. Simon, who, with Dr. Plotnikoff, developed Cylert for Abbott.

Administering Cylert to elderly patients at the Veterans Administration Hospital in Albany, N.Y., Dr. Cameron found reason for optimism and for further investigation: impressive gains in the MQ (memory quotient) scores of the individuals tested.

Towards supermen? The big difference between the experiments being conducted at the University of Michigan and all prior research is that, for the first time, an effort is being made to improve on nature when it comes to man's learning ability—not just to remedy a disease of old age.

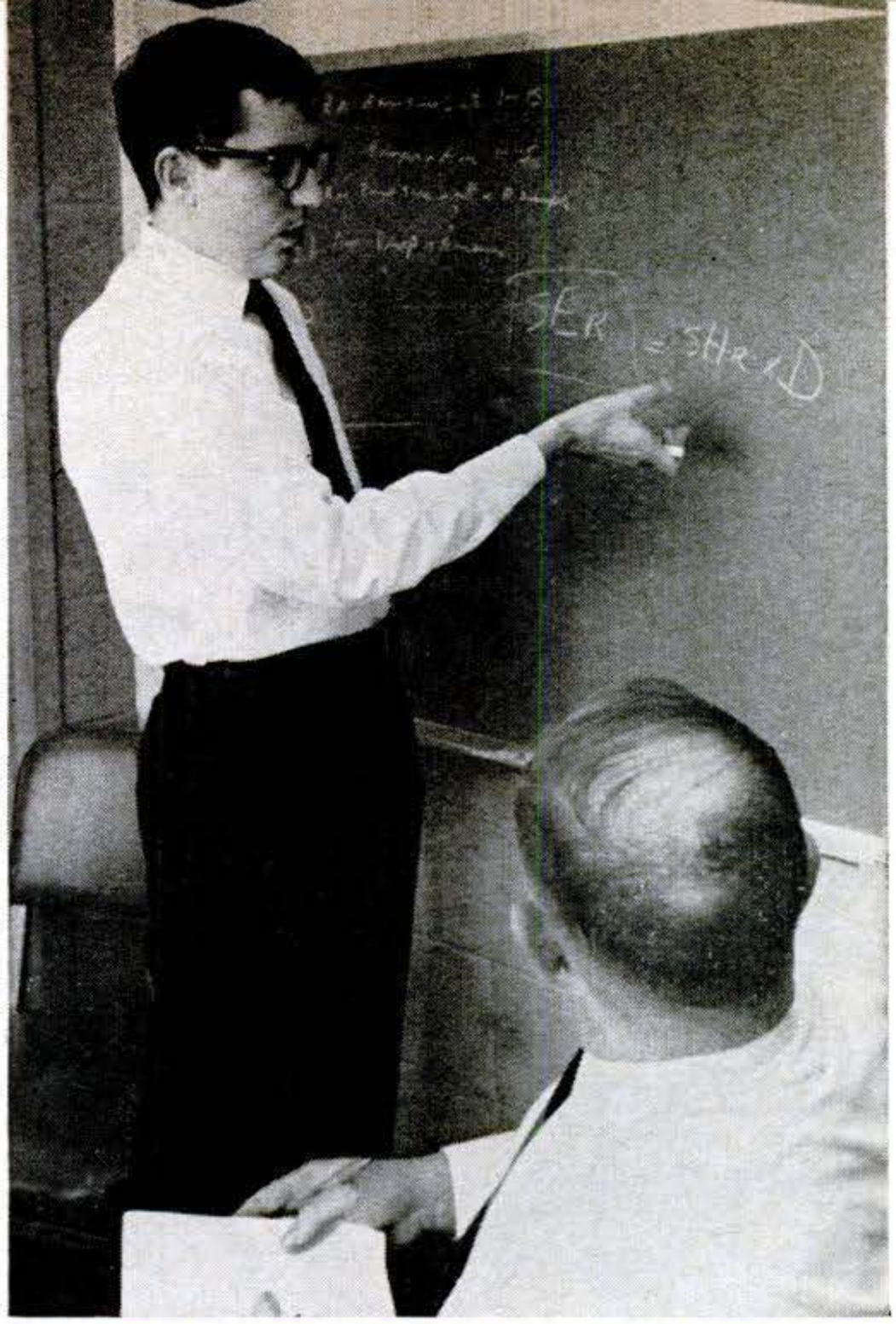
The 30 students participating in the experiments are healthy, intelligent men over 21; all have an IQ well above average.

Volunteers, after taking a battery of tests and receiving rough information on what to expect, show up at an appointed hour and receive a drug, the exact nature of which remains a secret. This is the so-called double-blind technique of experimenting with new drugs—neither the volunteer nor the doctor knows which drug is which, and the results for each drug can be calculated only by consulting a special key.

Five different varieties, or doses, of drugs are given. Since there is evidence that too much Cylert may hinder learning by causing a minor form of drug toxicity, while too little has no effect at all, the formula is given in three different doses.

Essentially, Drs. Burns's and House's "maze" for testing human intelligence is an elaborate electronic game in which the volunteer is asked to match his wits against a simple computer. What I was trying to do in the experiment I participated in was to learn, purely by trial and error, the answers to eight questions corresponding to the eight fingers.

The machine, following a program on punched tape, lighted the lights in a completely random order, and recorded my right and wrong answers separately along with the number of milliseconds it took



Dr. John T. Burns, first to try Cylert on normal persons, explains equation indicating that one's potential is equal to habit strength multiplied by drive. Drive may be increased by experimental drugs.

me to make each response. It also kept track of the total time involved.

The closed-circuit TV camera provides another rat-maze touch: With it, the expressions and actions of the volunteers can be viewed on a monitor. These range all the way from puzzlement, frustration, and anger to a look of intense concentration—factors that are often heightened or reduced by the effects of the drugs.

Will Cylert turn out to be a great boon to man—a drug that makes learning painless, rewarding, easy to accomplish?

"We don't know," says Dr. Burns. "Our results with Cylert have not yet been analyzed, and in any event it will be some years before we have anything more than tentative results. Even then, the use of these drugs will probably be limited.

"We do know, however, that drugs such as ordinary stimulants can improve learning and memory in cases of fatigue. Whether or not Cylert is the drug everyone is hoping for, it is the first of many psychoactive substances we will explore for mind-enhancing potential. Few experimental psychologists have used drugs in connection with memory and learning. It is evident that they are a very potent variable." PS

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"More car," says champion race driver Andretti to describe the effect of the new wider track, suspension, and steering system

THE NEW MUSTANG: They've Improved the

Surefooted as a mountain horse—that's the new Mustang, and with all of 320 horsepower under th

By MARIO ANDRETTI
PHOTOS BY BILL MORRIS

As soon as I saw the new Mustang on Ford's proving grounds, I knew it was a different horse from the one I used to own. The new wide-track chassis, the Wide Oval super-sports tires, the big, well-defined grille, and the sharp side sculpturing made me think of a Ferrari. Then the Ford engineers told me they had dropped the big 390-cu.-in. V-8 engine into it, and my desire to get in and drive it jumped another couple of notches.

But first I took a look under the hood. The engine looks enormous, crowding the spring towers for the front suspension on both sides. You'll need special tools just to change plugs—that's the price you have to pay for the extra performance. But most

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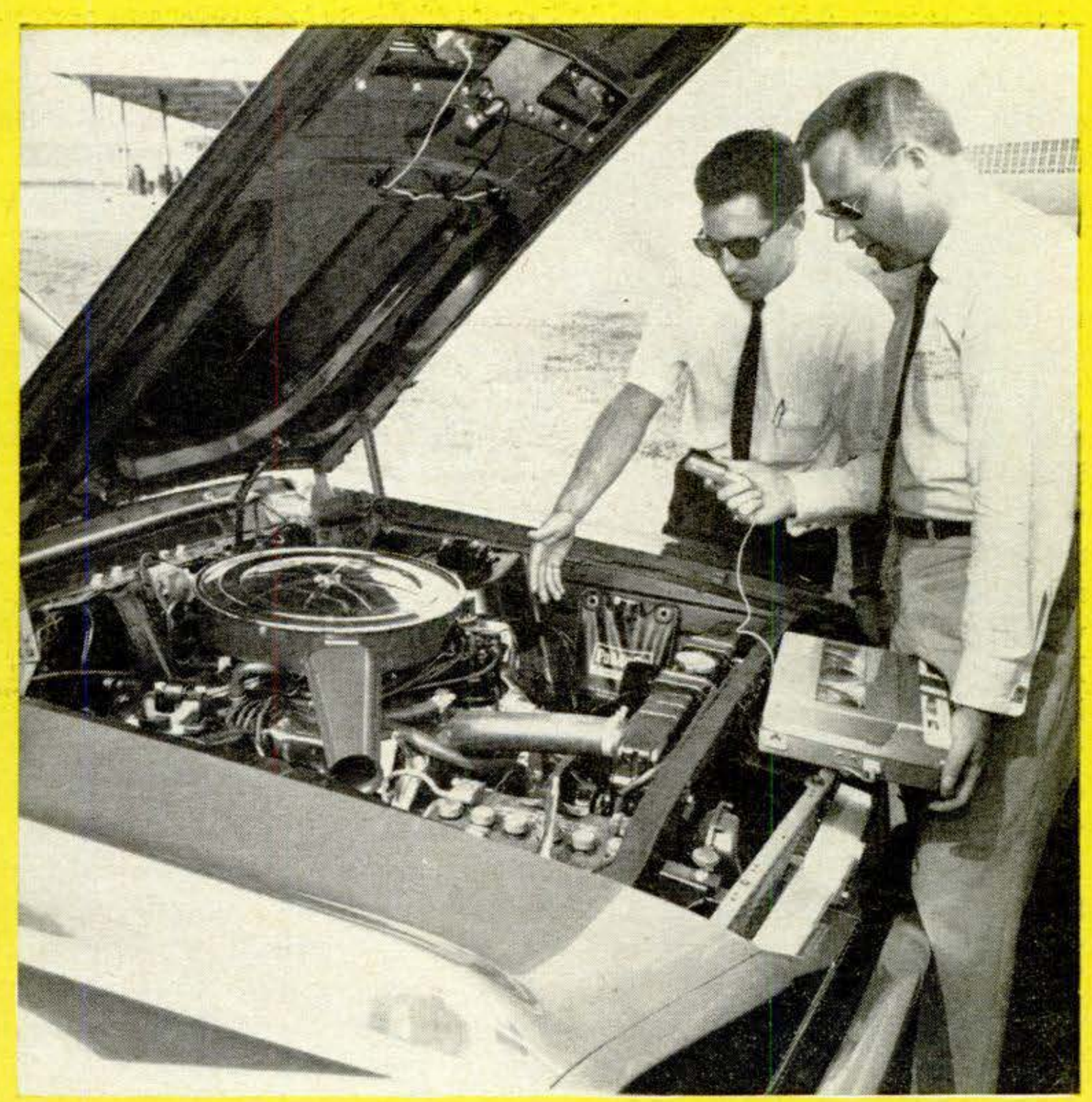
Mario Andretti (at wheel) tells PS Auto Editor Jan Norbye what he liked best about the new Mustang, and what he found missing. Norbye taped the story at the track side.

Breed

ood, it's ready to jump.



Andretti and Norbye discuss the engine and its accessibility. You need special tools to change spark plugs, they found, and both wondered if buyers will accept that penalty for the Mustang's new-found power.

maintenance items were well located. You can work on the distributor without even getting your hands dirty; alternator and power steering are also easily accessible.

Ford had lined up two different Mustangs to enable me to evaluate standard and GT models in relation to each other. First I saw the GT: It had a 390-cu.-in. engine with automatic transmission, power disk brakes, power steering, GT suspension, and F70-by-14 Firestone Wide Oval tires. The other car had the 390 engine with a three-speed manual floorshift, manual steering, drum brakes without power assist, standard suspension, and standard tires.

When I accelerated down the straight with the GT Mustang I compared its performance with the Camaro I tested last month [PS, Oct.]. The Mustang is a

Continued

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Mustang with standard suspension has pleasant ride at normal speeds and takes bumps easily.

heavier car than the 350-cu.-in. Camaro. It's also more powerful—although both cover the standing quarter-mile in about 15 seconds. Compared with last year's high-performance Mustang, with a 289-cu.-in. Ford V-8 developing 271 hp., the new 320-hp. engine really shines. Low-range torque is fantastic, and it's willing to run up to about 5,000 r.p.m. without any fuss.

Then I took it out on a snaky road course. There was one turn I could take at 90-95 m.p.h., but the automatic transmission didn't give me a gear that was just right there. I could kick down and get intermediate heading into the turn, but it would upshift a couple of seconds later, leaving me to ride through in Drive, waiting for the engine to pick up some revs when the road straightened out. If I had downshifted and held intermediate, that would have meant over-revving the engine. Mind you, this is an example of driving for extreme performance. The shift points proved fine for normal driving. For racing, I would have liked an intermediate gear taking me to 110 instead of 80-85.

There's no doubt this Mustang's power steering with revised linkage is good. The wheel was free of vibrations even on bumpy turns, and there was no lag on quick wheel movements. But for fast driving, I would have liked quicker steering. Instead of the 20.3:1 overall ratio used, I would have liked about 17:1.

The other Mustang had the still-slower 25.3:1 manual ratio, and without power assist that worked all right. But at speed, on a bumpy road, I got a lot of road shock and vibration in the wheel. On hard cornering, I needed both hands for the wheel where I had sailed through without effort in the other.

"How about that GT suspension?" you are probably saying. It's perfect. On good roads, it gives you a good ride, and on corners it keeps the car level and steady, heading where you want to go with very small steering-wheel movements, and no need for correction. It seems to suit all kinds of driving, but it's especially great if you're in a hurry.

The standard suspension is softer, and some people may find that it gives a better ride. But for race-track handling, it hasn't got it. On that 90-m.p.h. turn I was talking about, I needed only a quarter-turn of the steering wheel with the GT suspension and the Wide Oval tires. On the standard car, I couldn't go quite as fast, and I had to wind the wheel half a turn. This means

Mario grins as he points out where the Camaro found its inspiration: "That same stubby tail . . ." Mario likes the new hood on the Mustang, with dummy louvers that hold telltale lights for turn signals, but found he could see only the left one from the driver's seat. What's next for the Mustang? Maybe quad headlights? It needs better bumper protection, too.

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Mustang with GT suspension is squatter and corners flatter, but the ride is slightly rougher.

that the car wasn't going exactly where the front wheels pointed and I was rubbing the tires a little sideways. I took it right to the limit—if I had gone any faster, I would have had to increase the steering angle even more. Then the rear wheels would have broken loose, and the car would have spun.

On the GT Mustang, I could not find the cornering limit. The chassis, in fact, was capable of handling more power than the engine could deliver, which is saying something when you have 320 of those ponies working for you.

Both cars understeered. I like a fair amount of understeer, because it makes the car steady. For instance, I could use the brakes quite hard in the middle of a turn, and the Mustang remained stable and in full control. Understeer gives me a feeling of assurance, because it tends to diminish itself. If you overdo it with understeer, you back off a bit, and the front wheels get their bite back. Oversteer is the effect you get when a car exaggerates your steering movements, and I wouldn't be comfortable with that.

After having tried both these Mustangs, I want to say that disk brakes are worth whatever they cost, even for everyday cars. They slow the car quicker, without risk of side pull, and they don't overheat even when abused. They stand up well and maintenance is easy. It's one of the most valuable safety features you can get on a car.

I was comfortably seated in the Mustang, and the controls were easy to reach. I have to stretch a little to turn the key, in that recess, but that's a small point. The gauges are good-sized and placed right where I can see them. But isn't it time they put a foot-operated parking brake on the Mustang? Even the Falcon has that now. Another thing: The Camaro had a mechanism to keep the seat backs from flopping forward under hard braking or on a sudden stop. I really liked that—and the Mustang has no such hold-back provision.

Ford has managed to keep a distinctive Mustang look in the new car, even if the body is wider and different. They've kept the best things from the old Mustang styling and cleaned up the details that were wrong. I think Ford has a winner here. It's definitely more car than the old Mustang—and I think it's more car than the Camaro, too. PS

Facts on the 1967 Mustang

DIMENSIONS (inches)

Wheelbase	108
Front track	58.1
Rear track	58.1
Length	183.6
Width	70.9
Height	51.6

ENGINE

Type	OHV V-8
Displacement	390 cu. in.
Bore & stroke	4.05 x 3.78 in.
Compression ratio	10.5:1
Carburetion	Single 4-bbl.
Power	320 hp. @ 4,600 r.p.m.
Torque	427 lb./ft. @ 2,800 r.p.m.

CHASSIS

	Standard	GT
Axle ratio	3.00:1	3.00:1
Tire size	7.35 x 14	6.50/8.95 x 14
Brakes (swept area)	267.1 sq. in.	330 sq. in.
Brakes (power)	No	Yes
Steering ratio	25.3:1	20.3:1
Turns lock-to-lock	4.64	3.6
Turn diameter	37.2 ft.	37.2 ft.
Stabilizer bar	None	0.84 in.
Front spring rate (at the wheel)	125 lb./in.	154 lb./in.
Rear spring rate (at the wheel)	110 lb./in.	148.5 lb./in.
Curb weight	3,353 lb.	3,365 lb.

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Dr. von Braun (center) hails success of simulated 18-day moon mission by MSFC engineers H. Y. Grubbs (left) and M. J. Vaccaro.

Action-packed plans for exploring and sampling the lunar surface will make the most of astronauts' exciting opportunities to solve its mysteries

By DR. WERNHER VON BRAUN

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.

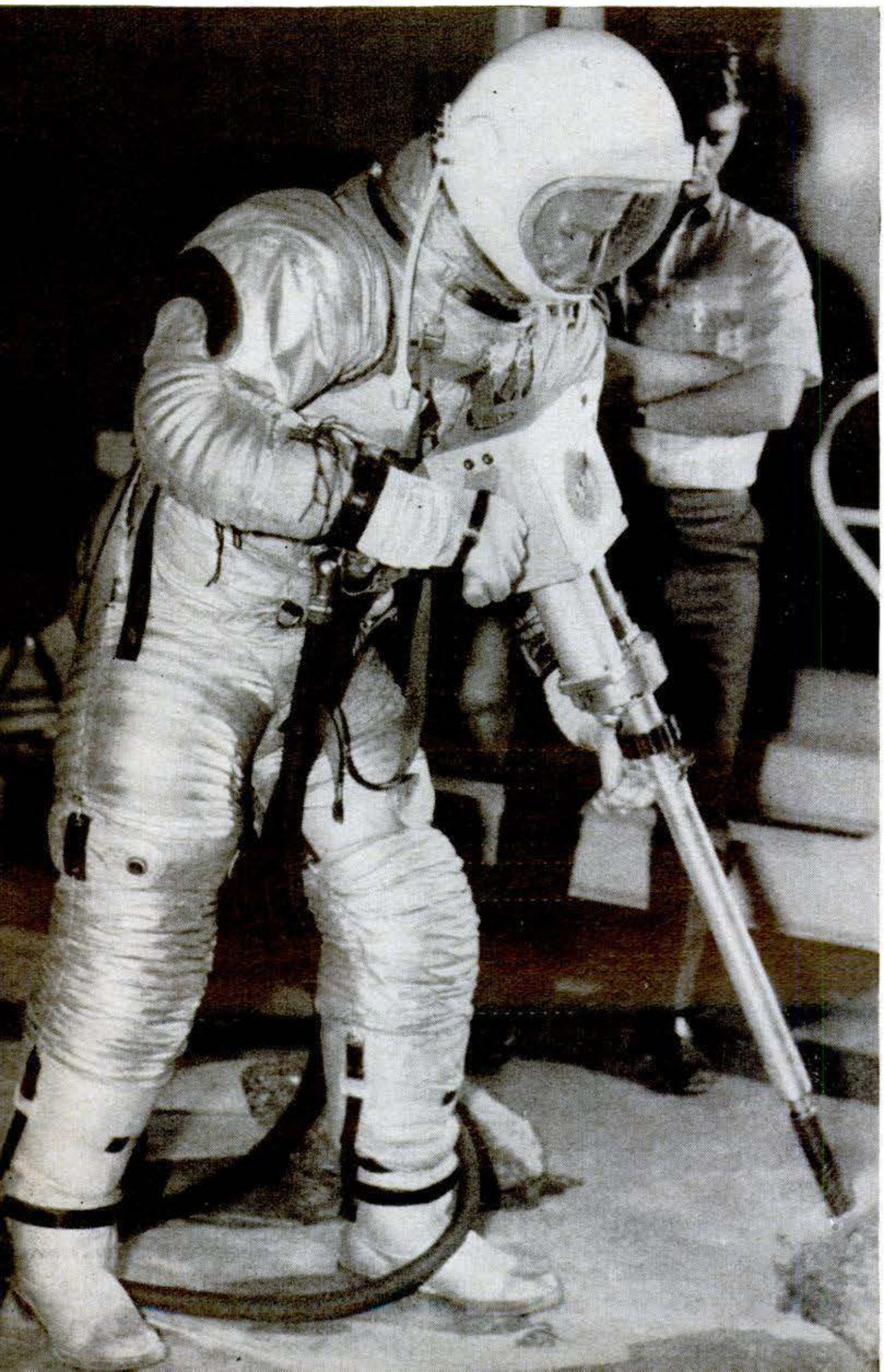
What

Our astronauts' first landing on the moon is now probably less than a thousand days away. What will they do when they get there?

Even the earliest and briefest missions will begin an exciting program of exploration to solve long-standing mysteries of the moon. This many-faceted program will later reach full swing when more-advanced spacecraft enable explorers to remain longer on the moon, and to make extended journeys across its surface.

The first comers. New details of what our first Apollo landing party will do, when the two astronauts have left their three-man mother ship in lunar orbit and set down their landing craft on the moon, have just been made public by NASA.

From touchdown to liftoff



Battery-powered core drill, a prototype of portable tool for cutting sample from solid rock on moon to bring back to earth, gets a trial at NASA's Manned Spacecraft Center in Houston, Tex.

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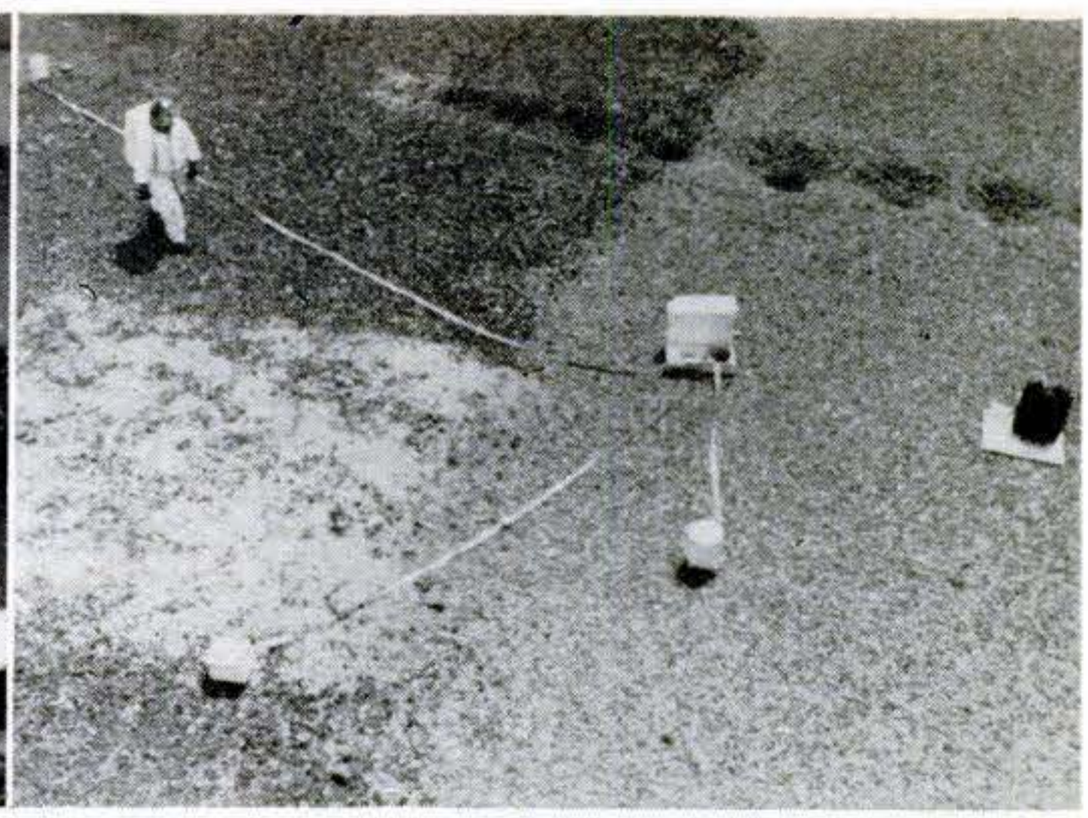
First astronauts on moon will leave instrument package like this to send data after they're gone. Its carrying bar becomes a mast for radio antenna.



On moon's surface, instrument package will be spread out, as rehearsed here with mock-up. Black object at far right represents its atomic battery.

We'll Do on the Moon

they will remain on the moon for 18 hours. Twice, both astronauts will emerge from a hatch of the Lunar Module, their landing craft, and venture together over the lunar surface—for three hours each time. The rest of their stay will be taken up in check-outs of their craft and life-support gear, communications, and a six-hour period for eating and sleeping between trips outside.

Sampling the moon. Collecting samples of moon rocks and soil, to bring back for study, will be a major activity of their six hours of exploring. They will take photographs of the lunar terrain, too, and inspect and measure the "footprints" of their own craft in the lunar soil. Finally, they will spread out on the lunar surface, a safe 300 feet away from their point of takeoff, an array of scientific instruments that will automatically radio information back to earth for at least a year after they have left the moon.

A mock-up of this Apollo Lunar Scientific Experiment Package (ALSEP) was recently demonstrated at NASA's Manned Spacecraft Center in Houston. It includes a variety of instruments to observe the lunar-surface environment, and others to probe beneath—by such means as a grenade launcher to produce artificial seismic waves, and a seismometer to detect them. An atomic battery called SNAP-27, being developed especially for ALSEP, will be the 50-watt thermoelectric power source. The astronauts will insert its plutonium fuel capsule after landing on the moon.

Moon mysteries to solve. From this modest beginning will unfold a vast project of lunar exploration designed to answer questions as varied as these:

Are there living organisms on the moon—perhaps completely different from any on earth? Microbiological experiments on lunar samples, from the surface and below, should tell. Likewise to be sought in the samples are primeval organic substances, like those from which life originated on earth—and oxygen and traces of water that might be extracted from lunar materials to help support future bases on the moon. Geologists will be eager to identify the lunar minerals themselves, and deduce the manner in which they were formed.

Is there a trace of a lunar atmosphere, and how much? Since it must be so tenuous that even Lunar Module rocket engines may contribute substantially to it, scientists urge beginning its study as near as possible to the start of the Apollo program.

What is happening in moon craters, like Alphonsus, that show signs of activity? These "thermally active" craters, the maria or "seas," and the cratered high-lands will be the three main types of lunar terrain of interest to explorers.

How was the moon born? Was it torn from the molten earth by solar gravity,

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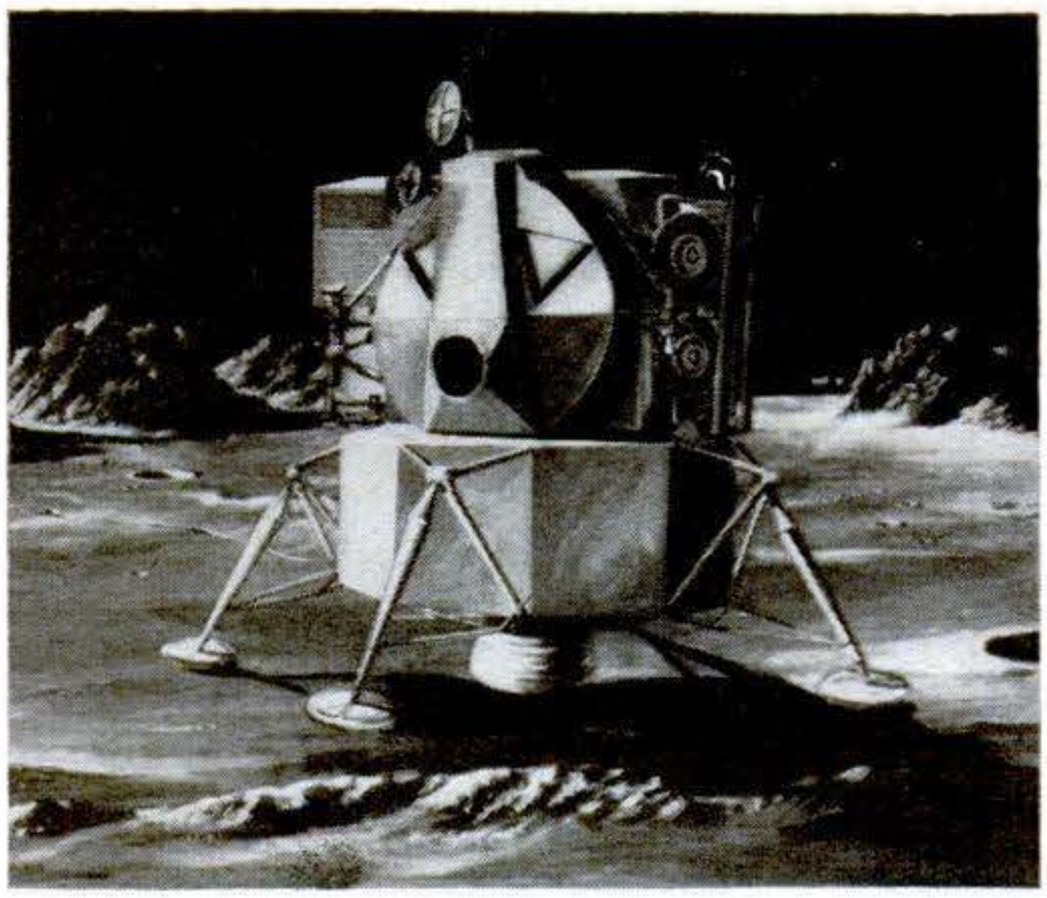
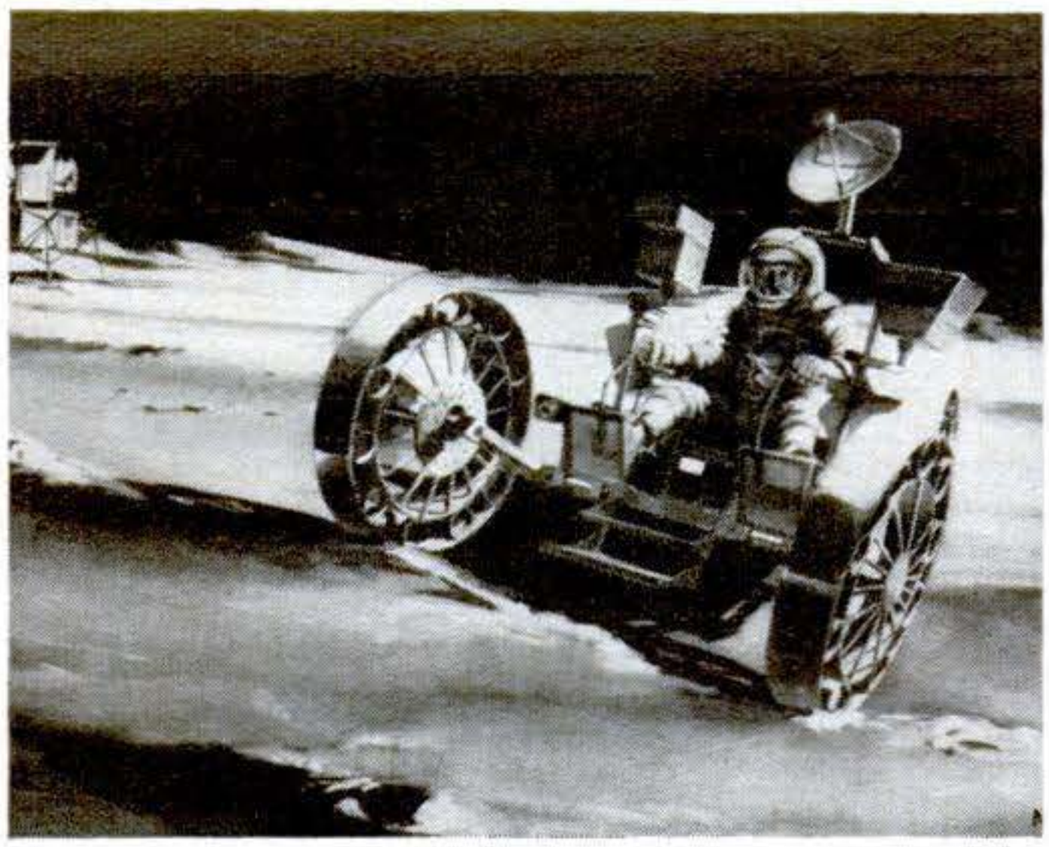
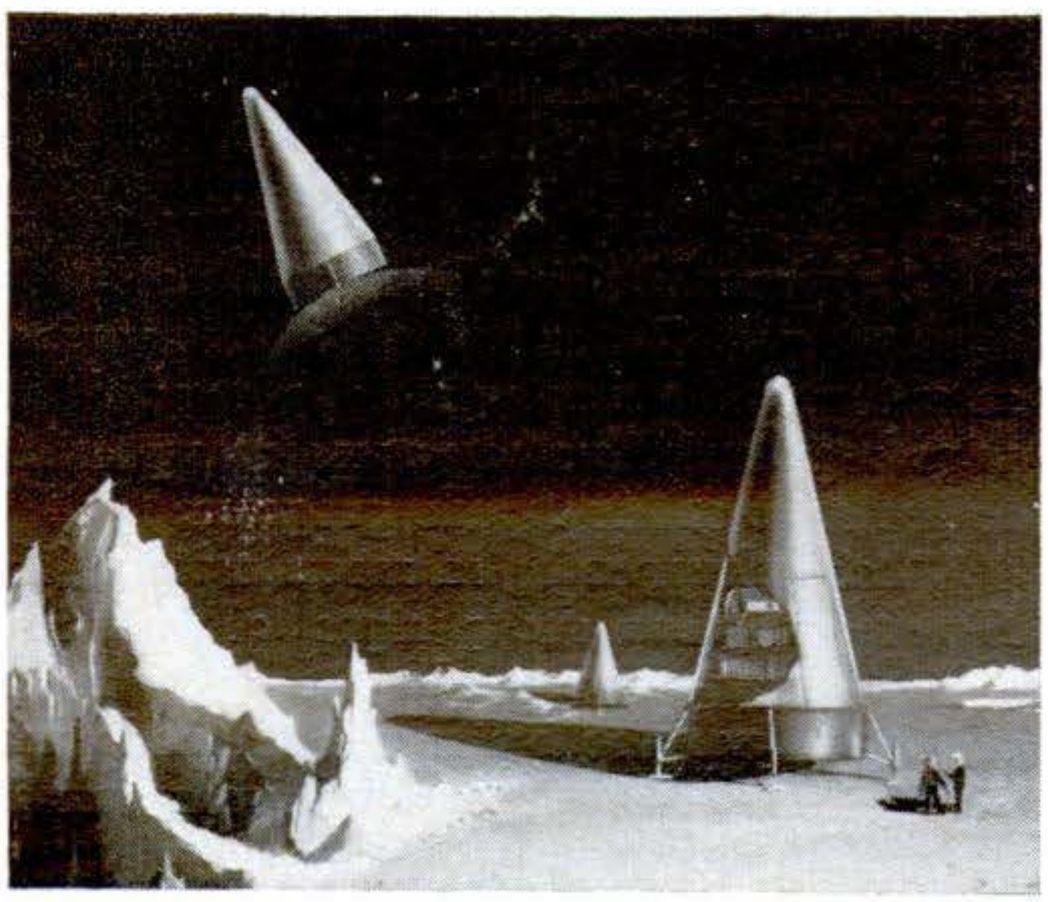


LM Shelter, an unmanned and modified Lunar Module landed on moon before astronauts' touchdown, could become their base for two-week stay. This is one of plans being weighed for extended missions.



This "Lunar Jeep" could be brought to moon on outside of LM Shelter. Moon vehicles will extend explorers' range, and give access to interesting features in terrain too rough for safe landing.



Unmanned cargo landers, launched by Saturn V rockets, could soft-land 30,000 pounds apiece on moon—opening way to large stationary and mobile lunar labs and, ultimately, permanent manned bases.

or did it and the earth condense from the same rotating gas cloud, or were moon and earth both built up from solid fragments orbiting the sun in disarray—the "accretion" theory now favored? Investigating the moon's history figures largely in a list of 15 key moon questions that the National Academy of Sciences, in close cooperation with NASA, has prepared. For this may well tell us more about the earth's own past. While our planet's birthmarks have been virtually eradicated by erosive forces like wind, rain, floods, and vegetation, those of the airless moon should be preserved.

Tools for moon explorers. Implements for answering such questions will include:

- Long-handled scoops to gather loose rocks, simple scales to weigh their load, and containers to seal them in.
- Drills to collect core samples, and probes to measure temperatures, in the outer 10 to 100 feet of the moon's crust.
- Seismic equipment to furnish information on the moon's interior structure.
- Magnetometers and gravimeters to measure local variations in the moon's magnetic and gravitational fields.
- Sampling containers and gas-analysis equipment to study the lunar atmosphere.

What's ahead? Early Apollo moon landings, limited to about 250 pounds of scientific gear, will not go far beyond the first landing in surface activities. These Lunar Modules will be unable to support a stay of more than 48 hours on the moon, and much of this time must be used to check out the craft for the flight back. Also, the stay must be limited to avoid fatigue. At the end of their two-week voyage to the moon and back, the crew will face the most strenuous, exacting, and critical maneuver of all—the precision approach and reentry into the earth's atmosphere at a blazing 36,000 feet a second, more than 24,000 m.p.h. Main emphasis will be on demonstrating the feasibility of the flight itself.

Follow-on flights with more-advanced spacecraft will permit much longer stays on the moon. Increased payloads will provide moon explorers with really sizable tools (like deep-drilling rigs) and with vehicles to make extended trips afield from the landing sites. Then will come the heyday of lunar exploration.

Advanced lunar-landing craft. One of two moon-landing concepts that look par-

[Continued on page 204]

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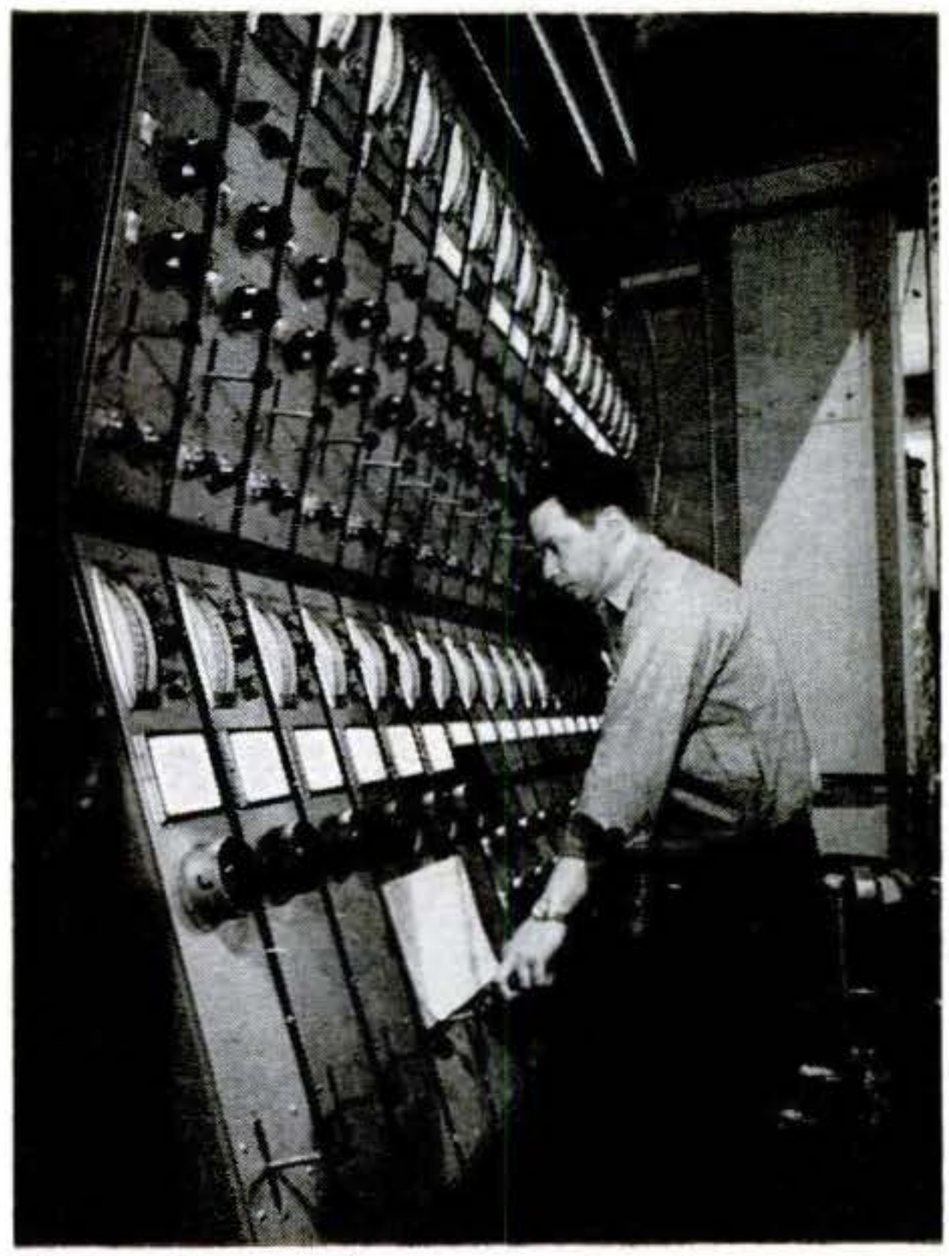
Automation comes to the opera

Scenery at New York's new Metropolitan Opera House, which opened this fall at Lincoln Center, is no longer shifted by hand as in the old days. The stage is now completely automated.

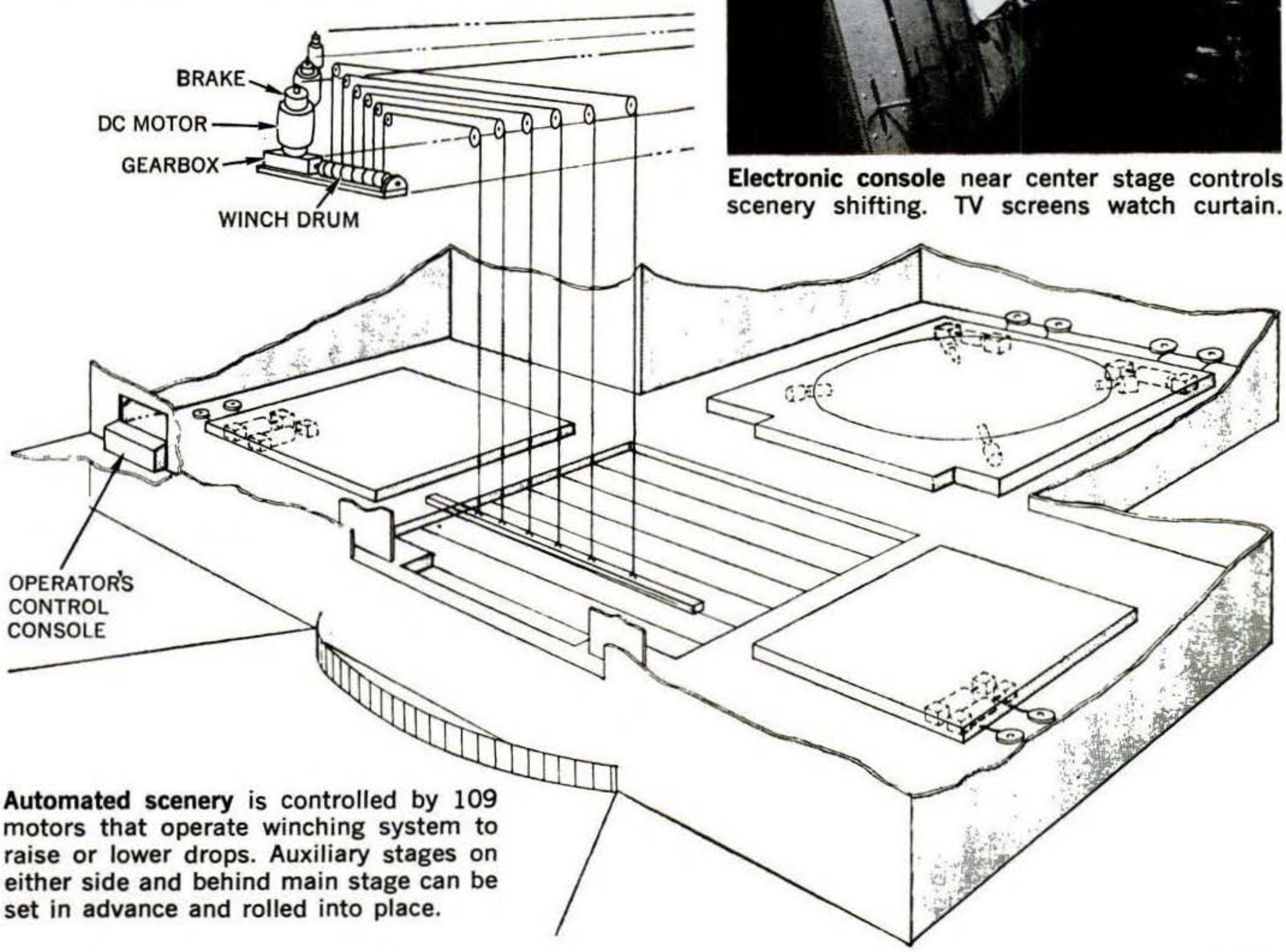
Replacing the bygone counterweight method of raising and lowering scenery, the new Met has a winch system 100 feet above the stage controlled by an electronic console. It can whisk sets away at three feet per second or as slowly as two feet per minute. In the system are 109 10-hp. motors.

In addition, there are three large movable stages, also controlled by motors, that can be set in advance offstage and rolled into place automatically. TV screens tell stagehands how far curtains are open.

The complex electronic system was designed and installed by Cutler-Hammer, Inc., of Milwaukee.



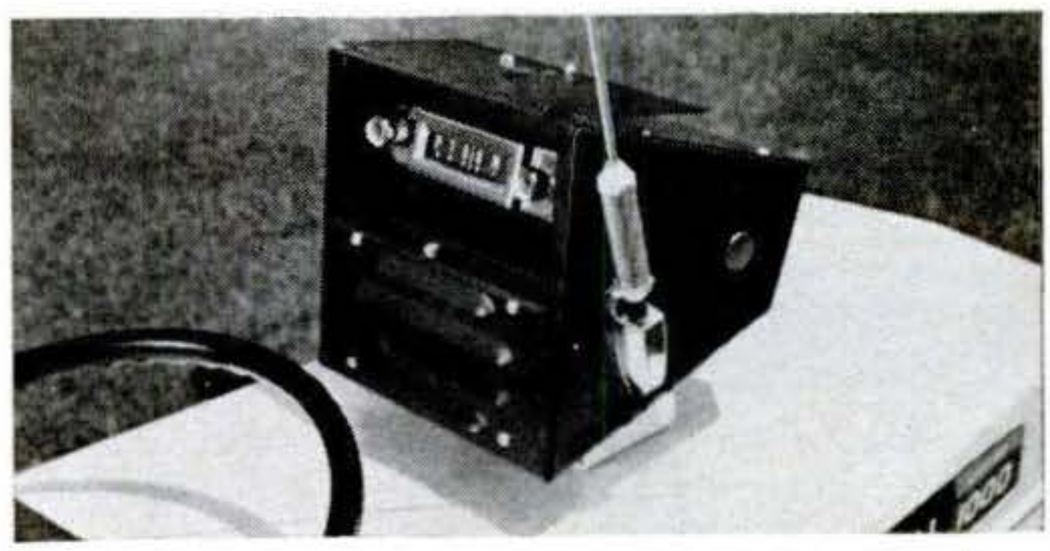
Electronic console near center stage controls scenery shifting. TV screens watch curtain.



Automated scenery is controlled by 109 motors that operate winching system to raise or lower drops. Auxiliary stages on either side and behind main stage can be set in advance and rolled into place.

Music while you mow the lawn

An all-transistor radio has been designed to mount on the hood of a riding mower and give you music or let you listen to the ball game as you cut the grass. The weatherproof unit operates on a 12-volt electrical system and can be installed by four cap screws. Its spring-mounted antenna deflects when passing under trees. Jacobsen, maker of mowers, builds it.



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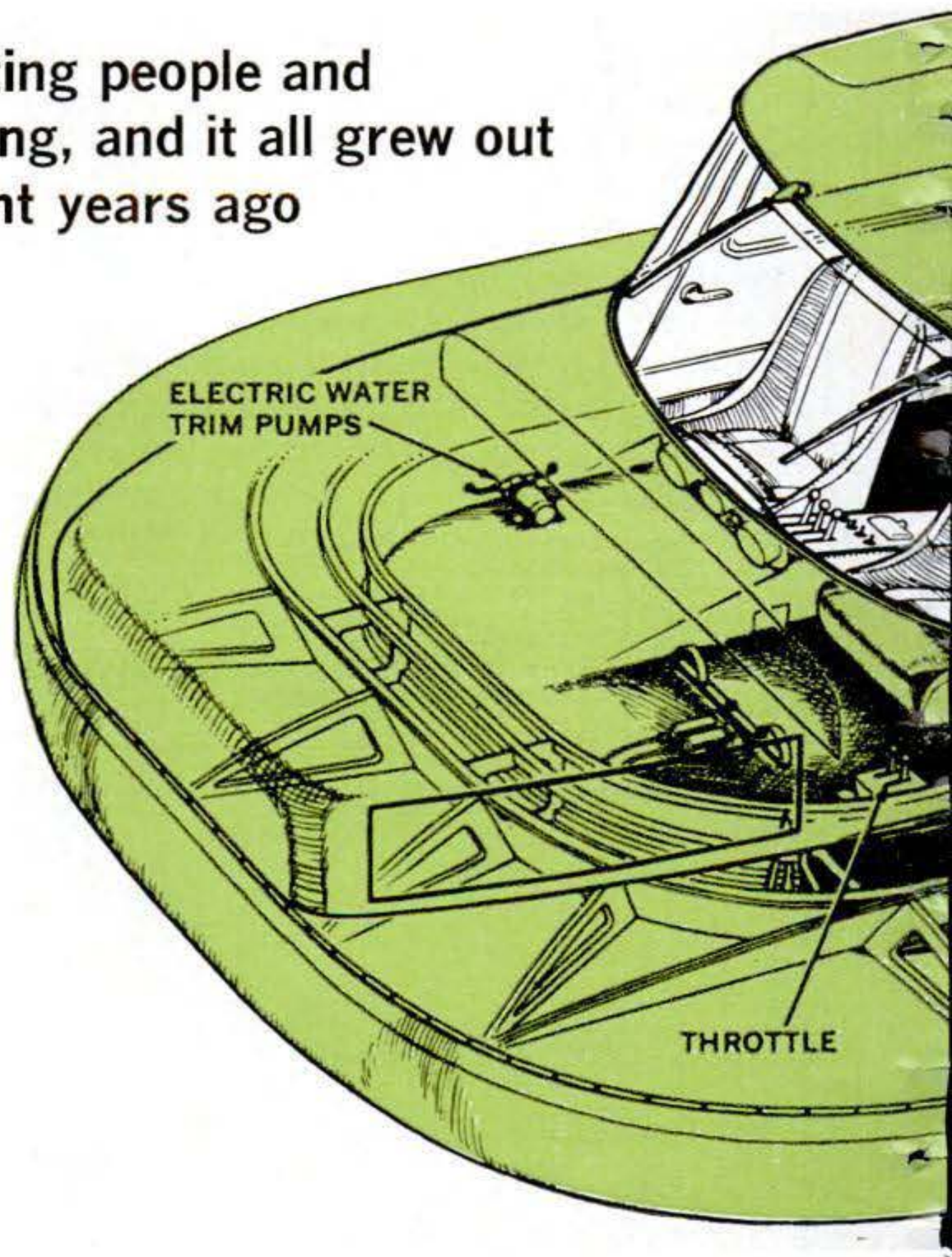
The age of the air-cushion vehicle

AMAZING HOVERCRAFT

A spectacular revolution in transporting people and cargo—by hovercraft—is in the making, and it all grew out of a hair dryer and a coffee can eight years ago

By **DAVID SCOTT** / *PS European Editor*



Recently, 2,000 captains of industry and military men from more than 100 countries gathered to take stock of and project a revolution in the transportation of people and cargo.

The weird and wonderful exhibits at this international conference, held near Portsmouth, England, were vehicles built on a brand-new principle that had come of age only eight years after a British inventor had demonstrated the germ of a unique idea with a hair dryer and a coffee can.

The vehicles are known as hovercraft.

Here's what that assembly of men—government officials, ship owners, and high-ranking military officers—forecast for hovercraft in the next few years:

- Trains skimming across the countryside over concrete rights-of-way at 250 m.p.h.
- Drive-on car ferries.
- Ocean liners that will cross the Atlantic in 24 hours.
- Craft for coast-guard work, marine ambulances, patrol boats, assault landing craft, and antisubmarine vessels immune to

Ferry carrying 250 passengers and 32 cars across English Channel at 88 m.p.h., starting in 1968, is shown in artist's impression. Six-foot skirts will keep the ferry running in waves 10 feet high.

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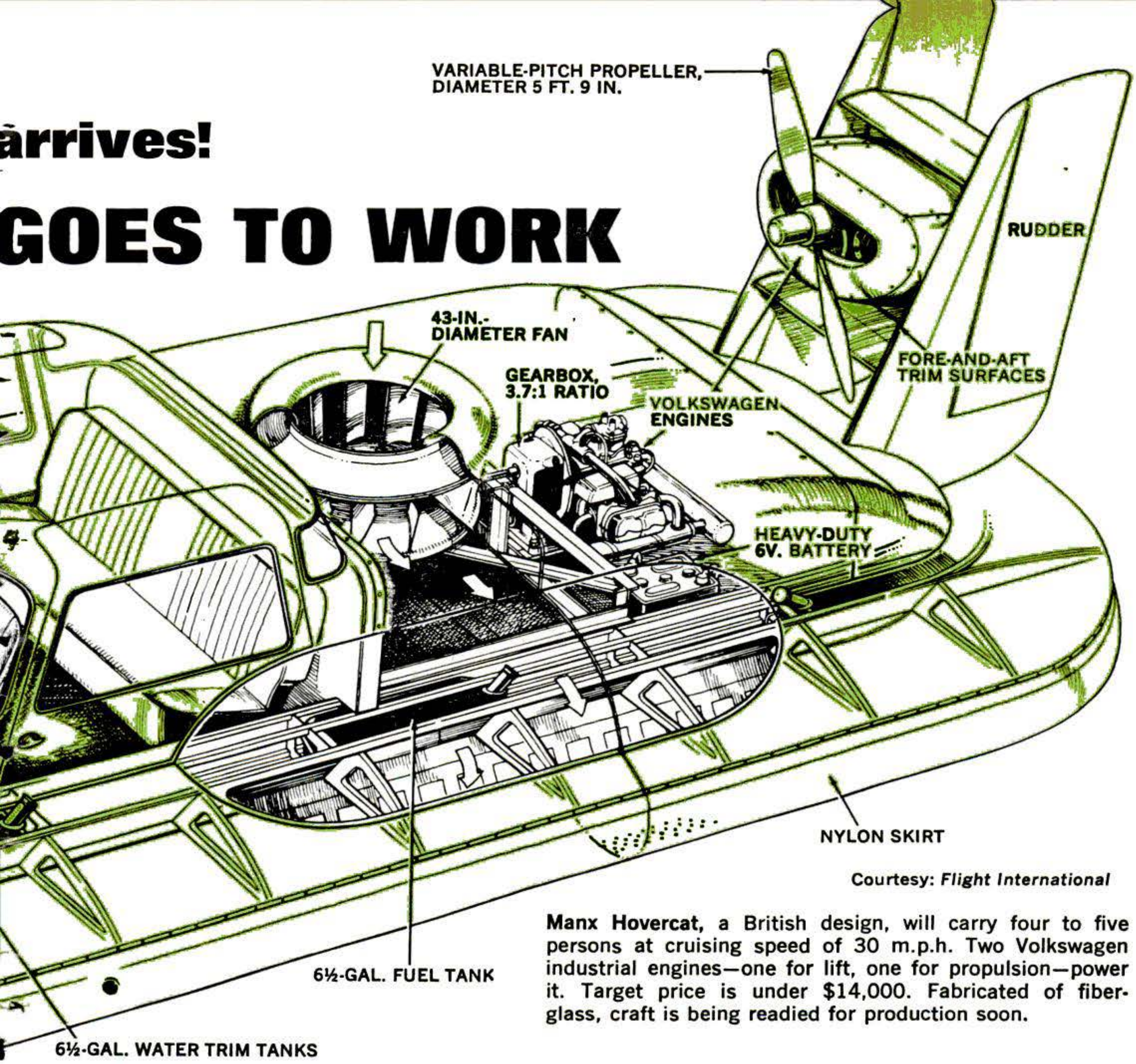
ärrives!

GOES TO WORK



Courtesy: *Flight International*

Manx Hovercat, a British design, will carry four to five persons at cruising speed of 30 m.p.h. Two Volkswagen industrial engines—one for lift, one for propulsion—power it. Target price is under $14,000. Fabricated of fiberglass, craft is being readied for production soon.

sonar detection and attack by torpedoes.

These are not dreams.

Hovercraft are now streaking across the English Channel in a fraction of the time required by surface vessels. They are operating across San Francisco Bay between airports. They are in Vietnam, on test as combat vehicles. They are on scheduled runs on Russia's Volga river.

Personal hovercraft runabouts powered by a brace of little Volkswagen engines are about to be manufactured.

Neither fish nor fowl. Hovercraft, also known as ACVs (air-cushion vehicles) and GEMs (ground-effect machines), are like nothing else the world of transportation has ever known.

They fit between surface ships and aircraft in an entirely new class. They ride on a cushion of air. They are amphibian. They can speed over open sea, beaches, or desert. They are undaunted by submerged rocks, ice floes, or soggy marshland.

They need only simple port facilities, can follow direct overwater routes independent of harbor channels, cost less to operate than aircraft, and simply float or drift to a hard-surface or water landing in case of an engine failure.

What in the world *is* this incredibly versatile machine? First, let's see how hovercraft came into being. The man who pioneered them was Christopher Cockerell. He first demonstrated his theory of air-cushion support in 1958 with that hair-dryer fan and the coffee can.

Cockerell departed from the two principal ways of moving an object over a surface: roll it like a wheeled vehicle, or slide it like a boat. His starting point was the skate and sleigh, which glide on a lubricating film of melted snow or ice.

He used air as the lubricant. He found that when blown through a tin can open at both ends, it formed a cushion that could

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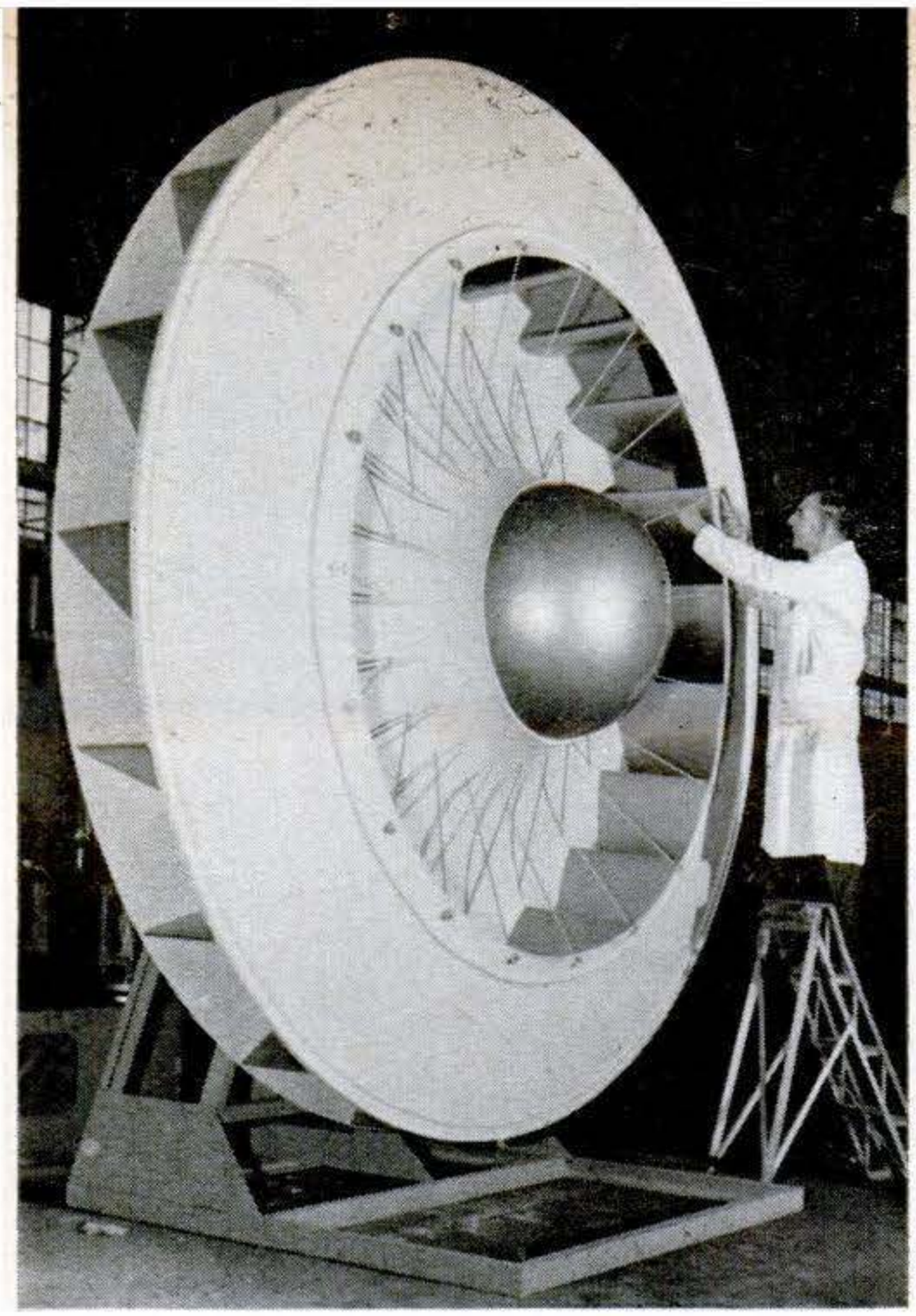
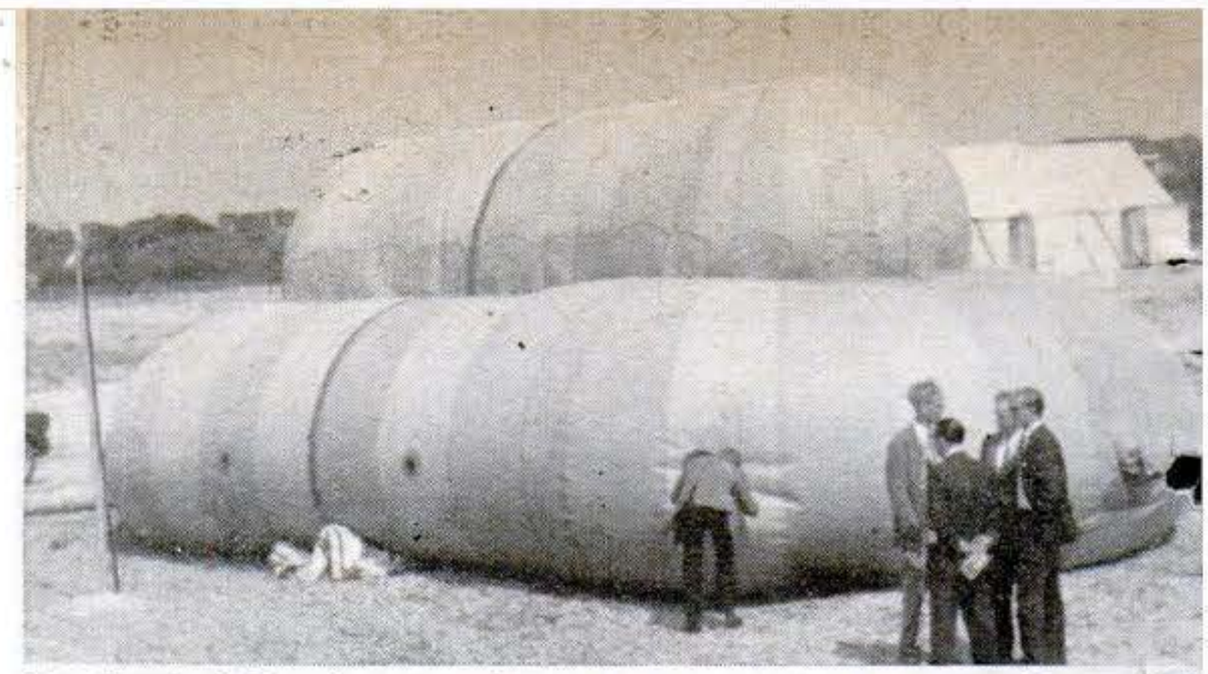


Lift fan is the heart of any hovercraft. Two of these 11-foot-diameter centrifugal units support a 14-ton, 24-passenger British model eight inches off water. Power comes from 425-hp. jet engine.



Double-bubble hovertrailer can tote nine-ton truck over water. Open-bottom balloon is inflated to ⅓ pound per square inch by blower in towing craft. Air cushion floats it a foot above surface.

Britten-Norman model CC.5 is exceptionally quiet because slow-running fans blow air for drive as well as lift. Convoluted "finger" skirt reduces drag on choppy water, is repairable in sections.

support a considerable weight. The downward thrust reacts against the ground, pushing back to create more lift than the jet of air alone.

The next step was containing the cushion to reduce the escape of air for maximum upward thrust with minimum blower power. Working with a model craft, Cockerell used a ring of down- and inward-angled air jets around the rim of the hull. The curtain of air (like those sealing open entrances of department stores in winter) both created the cushion and helped retain it.

The mini-skirt. A flexible skirt followed logically, and raised hover-height well above the few inches to which early rigid-rimmed craft were limited. Most of today's machines have a four-foot fabric extension, enclosing the air-curtained cushion, that permits clearing solid obstacles up to 3½ feet in height and waves up to seven feet. The skirt envelops surface irregularities, and air leaking around the edges acts as a lubricant that reduces abrasion and wear.

Come take a ride with me in this machine—one plying between Dover, England, and Calais, France. Our nine-ton Hovercraft is 48 feet long, 23 wide. It's powered by a 900-hp. turboprop engine that drives both a fan for lift and a pusher air propeller.

Our Hovercraft squats on the beach like an exhausted whale, its deflated skirt—which captures its air cushion—a flabby underbelly. We walk up the bow loading ramp into the cabin and take a seat (one of 38) by the window. The door swings shut and the gas turbine comes to life with the rising whine of a jet aircraft. Gently the ground drops away, but only four feet. The movement is hardly noticeable. Then comes the spewing of sand and gravel on all sides. We're on the cushion, airborne!

The captain revs up the propeller in reverse thrust and we back out onto the water. Instantly we're cocooned in a cloud of mist, with rivulets streaking down the window. Slowly the craft slews around, the prop gives a roar of solid power, and we're headed out to sea. As we pick up speed, the mist disappears, left behind.

Soon we're moving over choppy water at 60 m.p.h., but the sensation is more like gliding than boating. The wind increases as the English coast shrinks away over the craft's flat wake, and now we hear the bumps of wave tops but barely feel them. It's still smooth sailing, like riding in a fast sports car with taut suspension.

Looking down, we find we're moving

Now! PS lies flat on your bench or table.

Ready for action, this is one of three hovercraft being used as armed patrol vehicles in South Vietnam's Mekong Delta. It's a Bell, made in Buffalo, **N. Y. Both fan and aft-mounted prop are driven by** 1,000-hp. General Electric marine gas turbine. It easily travels over water, sandbars, and rice paddies. Designated PACV (for Patrol Air Cushion Vehicle), **it can make 65 m.p.h. at four-foot altitude.**

crabwise. A crosswind is blowing the skimming craft off course, and the captain is correcting with reverse rudder.

Farther out, there's a mild swell, but the machine only quivers gently as it rides the peaks. There isn't the pitching and rolling you'd get in a small ship.

At Calais we settle gently onto the beach. We've made the crossing in 45 minutes. Surface ships take an hour longer.

Hovercraft, you might sum up, are a pretty good form of travel for people afraid to fly and prone to seasickness.

Any bugs? We've already seen one problem on our cross-Channel ride—an embarrassing lack of directional stability. Hovercraft need lots of room for turning around in wind.

"It's like driving a car on sheet ice," said one pilot.

This may be solved by propellers carried on rotatable pylons. Vectored thrust can counter crosswinds, greatly reduce sideslip on turns, and improve maneuverability at slow speeds when aerofoil surfaces have little effect. Sideports in the air-cushion walls could also provide lateral thrust for steering. Retractable wheels like an aircraft undercarriage would provide positive guidance on terminal aprons. All these are being tried out on a British research craft.

Skirts are getting lots of attention. One scheme is automatic profiling of the hemline to follow irregularities of the water or terrain surface. Sensors detecting craft attitude and surface contours would operate an array of small winches around the hull. This would act as a suspension system to stabilize the hovercraft for greater comfort, while reducing skirt wear and air losses.

Terminals are an immediate problem with the growth of commercial services. A firm of London consultants has a design that licks hovering instability, speeds loading and unloading, and cuts noise to boot. It's a landing guidance and docking system that uses a bell-shaped apron to funnel in an approaching craft.

Noise is another problem, although this is far worse for people living near terminals than for passengers. Propeller blade tips approach the speed of sound at peak revs. They're working on hushed-up props with much broader blades to give the same thrust and efficiency with half the tip speed.

Then there's blow-by from the cushion, and the self-made sandstorm that erupts during stationary or slow-speed hovering over beaches. The grit particles can foul a

[Continued on page 176]

. New "Perfect Binding" makes easy reading

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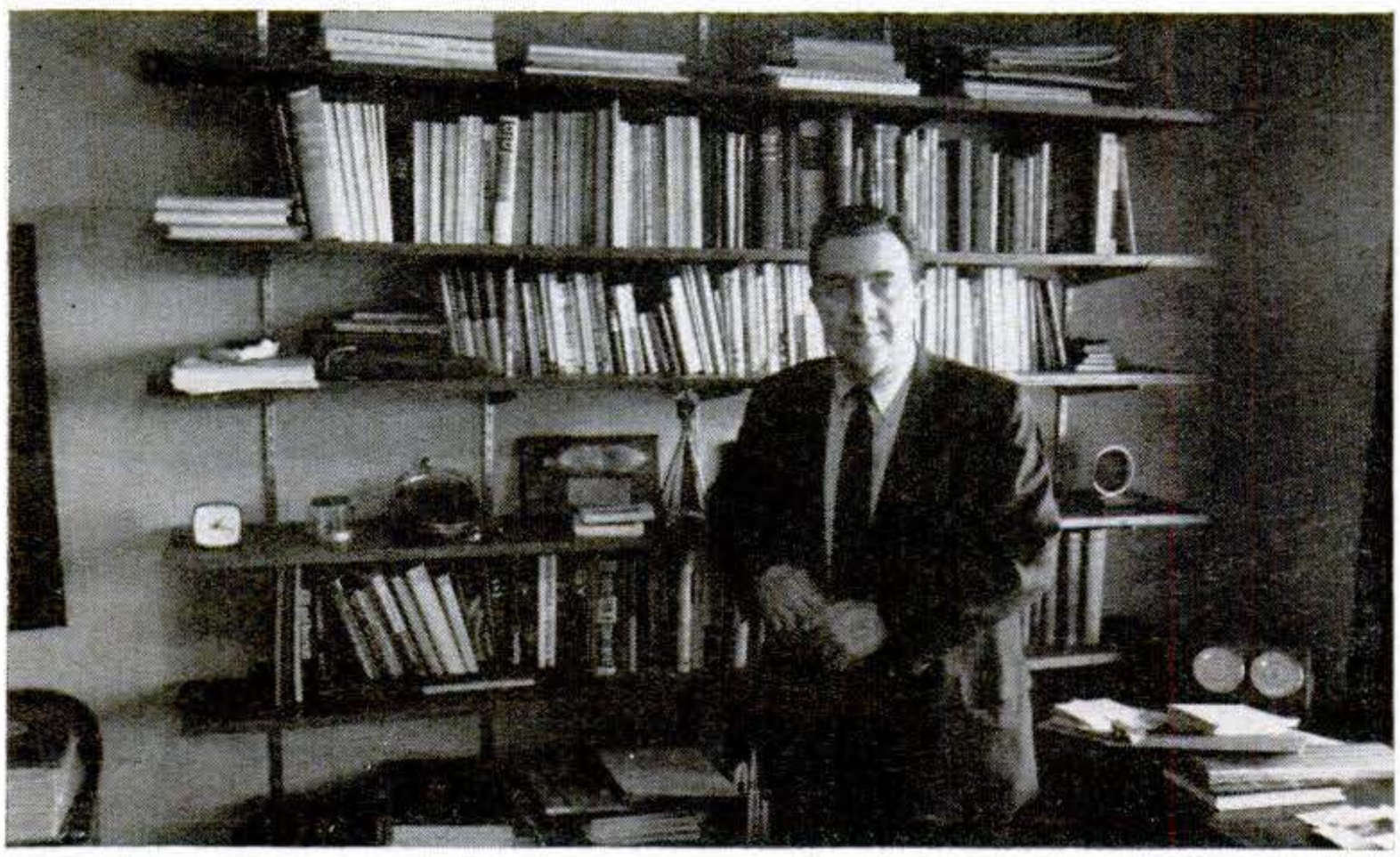
How does the down-to-earth hobby of woodworking mix with space physics? Here, the discoverer of the Van Allen space belts tells why he owes his success to his tools

From Outer Space to Basement Workshop



A 15-by-20-foot basement room contains Van Allen's modest shop—lathe, power saw, drill press, and hand tools. Strictly for enjoyment, he has constructed desks, tables, chairs, a bed, and many other handsome pieces.

By JAMES A. VAN ALLEN

One of America's foremost space physicists, Dr. Van Allen, 52, is best known for his discovery of the Van Allen belts, bands of deadly radiation that encircle our earth. The Van Allen belts were the first major discovery made by space satellites—satellites that he helped to design and instrument. Officially an expert on cosmic rays, Dr. Van Allen also knows about and works with shop tools. He heads the Department of Physics and Atsronomy at University of Iowa.

The physics of outer space may seem a long way away from the basement workshop where I build and repair furniture, but I credit whatever success I've had in both fields to my early introduction to tools.

In the early years of rocket research after World War II, all we had were captured German V-2s to lift our equipment to altitudes of 100 miles, the beginning of outer space. The fact that I could use a soldering iron and pliers gave me an edge over my colleagues. That was how I was able to do significant high-altitude physics research with those early rockets.

Thanks to my love of tools, I've probably also repaired more broken furniture than any of my colleagues. Each furniture-repair job becomes a challenge, a unique test of my ingenuity. I usually spend much time thinking about how I will fix whatever it is that I am working on. I seldom make drawings, even for new work. Most of the time, I work out of my head, writing down one or two key dimensions.

I started working with wood in high school, and even today it is my favorite pastime. In the shop, I'm completely absorbed by what I'm doing—the only thing I enjoy more is ordering tools for special jobs or browsing through hardware stores.

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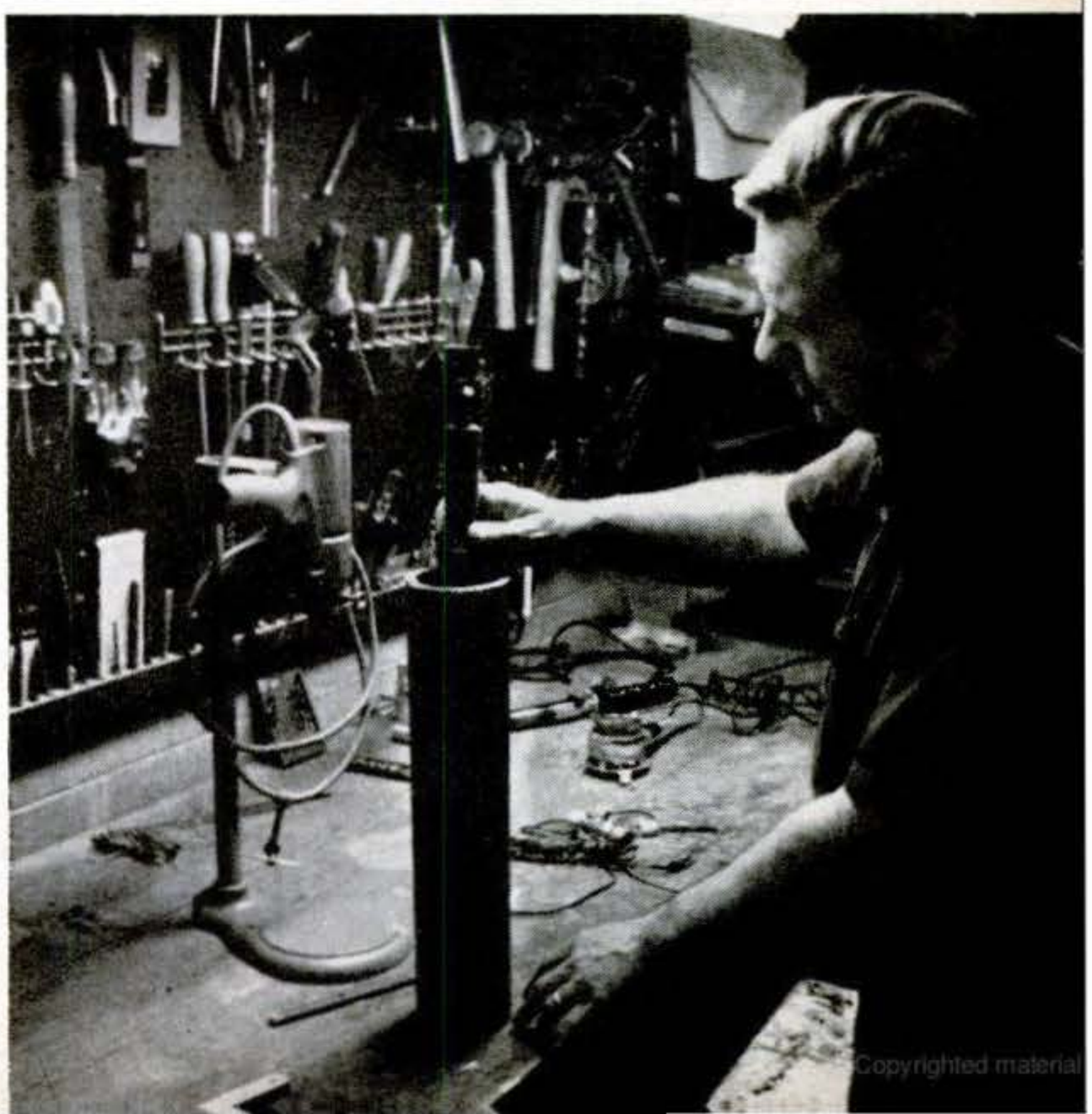
I left woodworking behind when I was in college. That's when I learned metalwork and electronics—both skills that we used to make equipment for physics experiments. For years after, this was the only kind of shopwork I did: During World War II, I helped develop the proximity fuse for the Navy; after the war I helped make equipment for my experiments on the V-2 rockets.

Back to woodworking. I got hooked on woodworking again in 1946 when my father-in-law asked me to help build a frame fisherman's shack with a stone fireplace. When we finished the shack, I started putting together a shop.

The first tool I bought was a secondhand Sears eight-inch bench saw—still my central power tool and the most useful power tool a man can have. Then I bought a new Delta wood-turning lathe. Since then I've

Continued

A painstaking craftsman, Van Allen prepares a lamp tube to receive the turned mahogany top shown being turned on the lathe in the photograph above.



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"A shop is a place to get away from things and think about wood"

"Broken furniture is a challenge," says Van Allen, who prides himself on making "impossible" repairs.

added a ¼-inch power drill which I've attached to a stand so I can use it as a drill press; and a ⅜-inch portable drill.

I've also acquired an assortment of hand tools including screwdrivers, chisels, turning tools, etc. My workbench is ancient and made of oak.

Right now I've got about all the tools I need—except that I do plan to buy a power jointer-planer some time in the future. I don't have a lot of money invested in my shop. A few hundred dollars would buy the whole outfit.

My present shop is just about the right size, 15 by 20 feet. The floor is raw (but level) concrete; the walls are painted concrete blocks. The furnace is at the other end of the basement room so that my shop is warm and dry all year long. There are big windows on one wall and I've hung fluorescent fixtures so that there is ample light over the work areas. I've also provided an overhead electric plug-in bus so that there's plenty of juice where I want it. The eight-foot ceiling is open, so that there is level storage space for lumber between joists.

Walnut, which is native to Iowa, is my favorite wood. For years I used wood from an old walnut tree my father had sawed down. Now I find that I am using more and more Philippine mahogany—mostly to match the cabinets and woodwork built into our present house. Also, it is great to work with, turns nicely, has a fine grain, and is not expensive. Both woods have the additional advantage of being easy to finish.

This last part of woodworking is the one I like least. The simpler a project is to finish, the better I like it. Also, I don't like shiny, high-gloss finishes. I've been simply rubbing walnut and mahogany with boiled linseed oil. Lately I've switched to Deft, thin varnish that is easy to apply.

It's hard to say how I decide which project to work on at any time. The practical need at the moment probably is the most important component of my decision. Often, it is simply a matter of something needing to be fixed. But, like any wood hobbyist, I also have to be in the mood to do it. If I've had a tense day at the laboratory and come home to find that the laundry drying rack needs repairing, I welcome the chance to fix it. Or, if it's a nice weekend and I feel like hammering together an outdoor playhouse for the children, that's what I do.

Other projects. There are always plenty of homemade projects around. Here's a sampling:

In the kitchen, I built the cross-legged understructure of our family table, then put the laminated-plastic (Formica) top on. I also recently turned some lids on the lathe for a set of china crocks my wife bought at an antique sale.

In my home office, the desk is an old door, stained walnut and mounted on four legs. (I'm now designing an old-fashioned kind of solid-walnut desk, a reproduction of the desk my grandfather, George Van Allen, used here a century ago in his land-title business.)

In various bedrooms are the four-poster bed (used by a daughter), a desk and chair (used by a son), and other items.

Under the fireplace in the family room is another project of which I'm proud. These are storage bins for our younger children's toys. The bins are built on casters and are just the right height so that they can be wheeled out of the way under the stone bench that juts from the hearth.

As I said, my diggings (as I call my shop) serves a practical purpose—getting things done around the house. It also gives me a place to get away from the world and think only about wood. PS

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"I'd like to see them make..."

DRAWINGS BY DANA RASMUSSEN

Roll-up shower "doors" of fiberglass, like a window shade. Rolled out of the way, they'd ease tub cleaning, give more air circulation for tubbers. —*Tim Collins, Shaker Heights, Ohio.*

A lighter strobe flash with less bulk, too. Why couldn't makers incorporate both the batteries and the condenser in a heavy and flexible neck strap?—*Warner Walker, Exeter, Calif.*

Lever-operated cable clamps for quick-changing car batteries, or for charging batteries in cars with an alternator. A tailnut with a cam face would do it.—*Ben Hempel, Minneapolis.*

Plastic putty in three-sided strips with contact adhesive on two sides. You'd just press it in place when glazing, or peel it off to replace the glass.—*Eric Levy, Chicago.*

Studs for bicycle tires that you could drive in with a conventional stud gun. School-bound cyclists and newspaper deliverers need safer winter riding.—*Joel Hartway, Sterling, Colo.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

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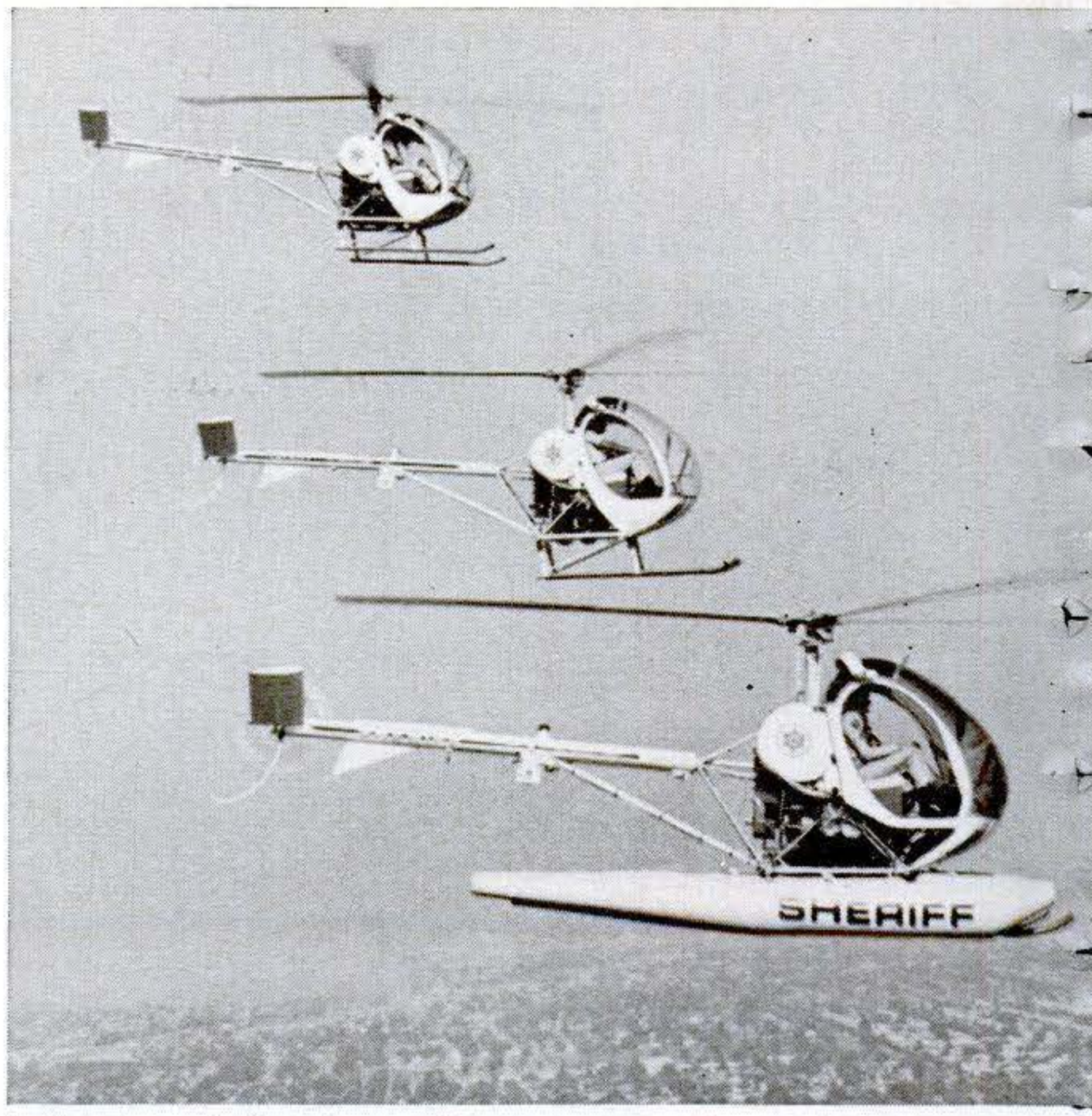
Airborne police patrol keeps crime in check

Project Sky Knight, an airborne law-enforcement patrol, is being watched by cities across the U.S. in its year-long test now being conducted in Lakewood, Calif., a suburb of Los Angeles.

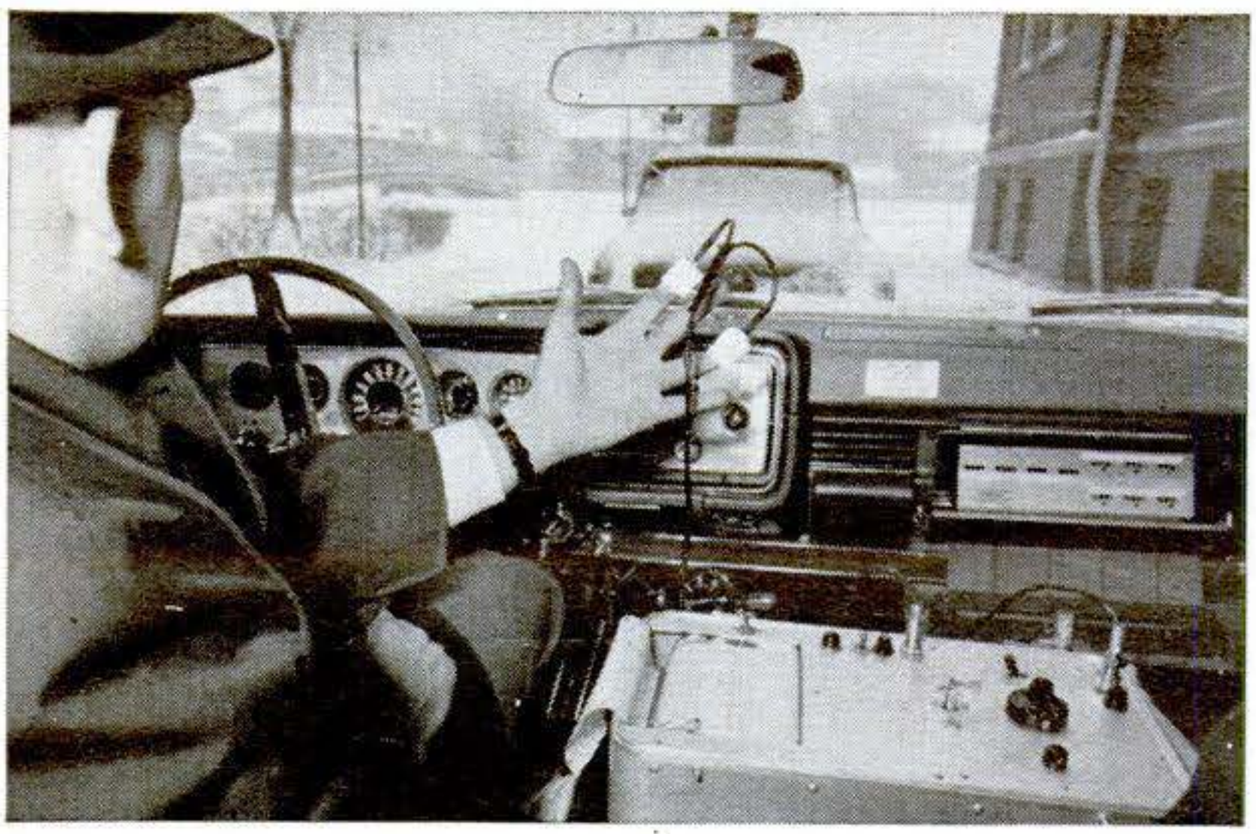
Through the night and most of the day, one of three two-man helicopters is in the air flying a regular beat. In case of need, it can reach any of Lakewood's 22,000 homes in 2½ minutes. Law enforcement is provided under contract by the county sheriff's office.

Each copter is equipped with two-way radio, a high-intensity searchlight with a beam powerful enough to illuminate an area nearly as large as a football field, and a public-address system for bullhorn announcements and warnings from the air.

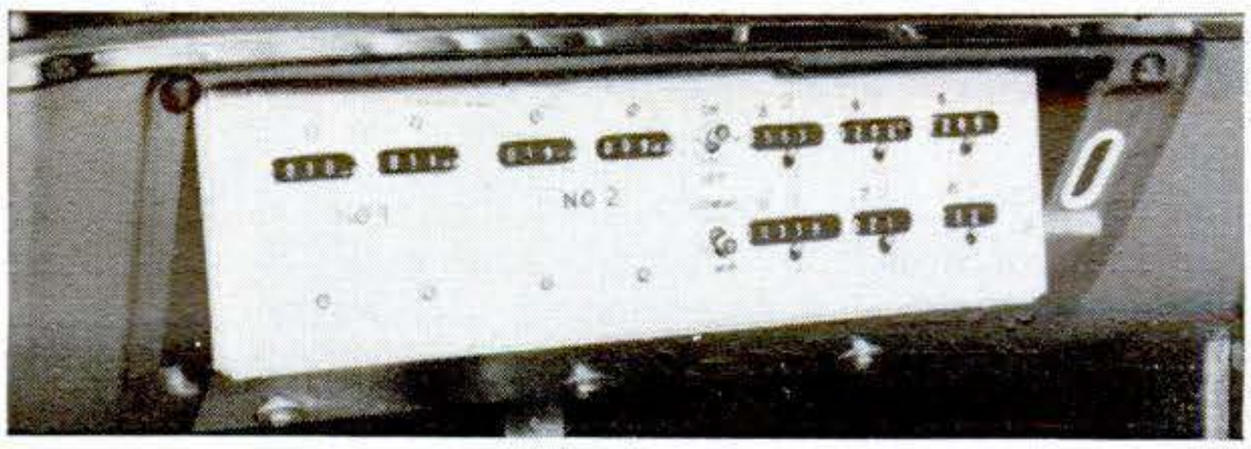
One store in the town has its burglar-alarm system tied in with a blinking light aimed skyward to attract help from the air, in emergency.



Helicopter patrol cruises at 80 m.p.h. over suburban Lakewood.



Taped and wired fingertips of driver measure his reaction to heavy traffic encountered as lie detector on seat makes record.



Drivometer in glove compartment records movements of the steering wheel, changes of speed, and application of brakes.

Lie detector records reaction of driver to traffic

A lie detector and an instrument called a Drivometer are being used on Detroit motorists to determine how nervous they get when the city's freeways are jammed with traffic.

The lie detector, called a GSR for galvanic skin response, is wired to a driver's fingertips to measure blood pressure, heart beat, and other reactions to stresses while driving.

The Drivometer, developed by Ford and the University of Michigan, double-checks the lie detector's results. A boxlike apparatus 10 inches long, four high, and six deep, it fits in the car's glove compartment. Ten counters in the device are connected to the speedometer and basic car controls. They record steering-wheel movements per minute, speed-rate changes, accelerator changes, brake applications, the time the car is in motion, and the total trip time.

Some 150 drivers with both good and poor records have been tested.

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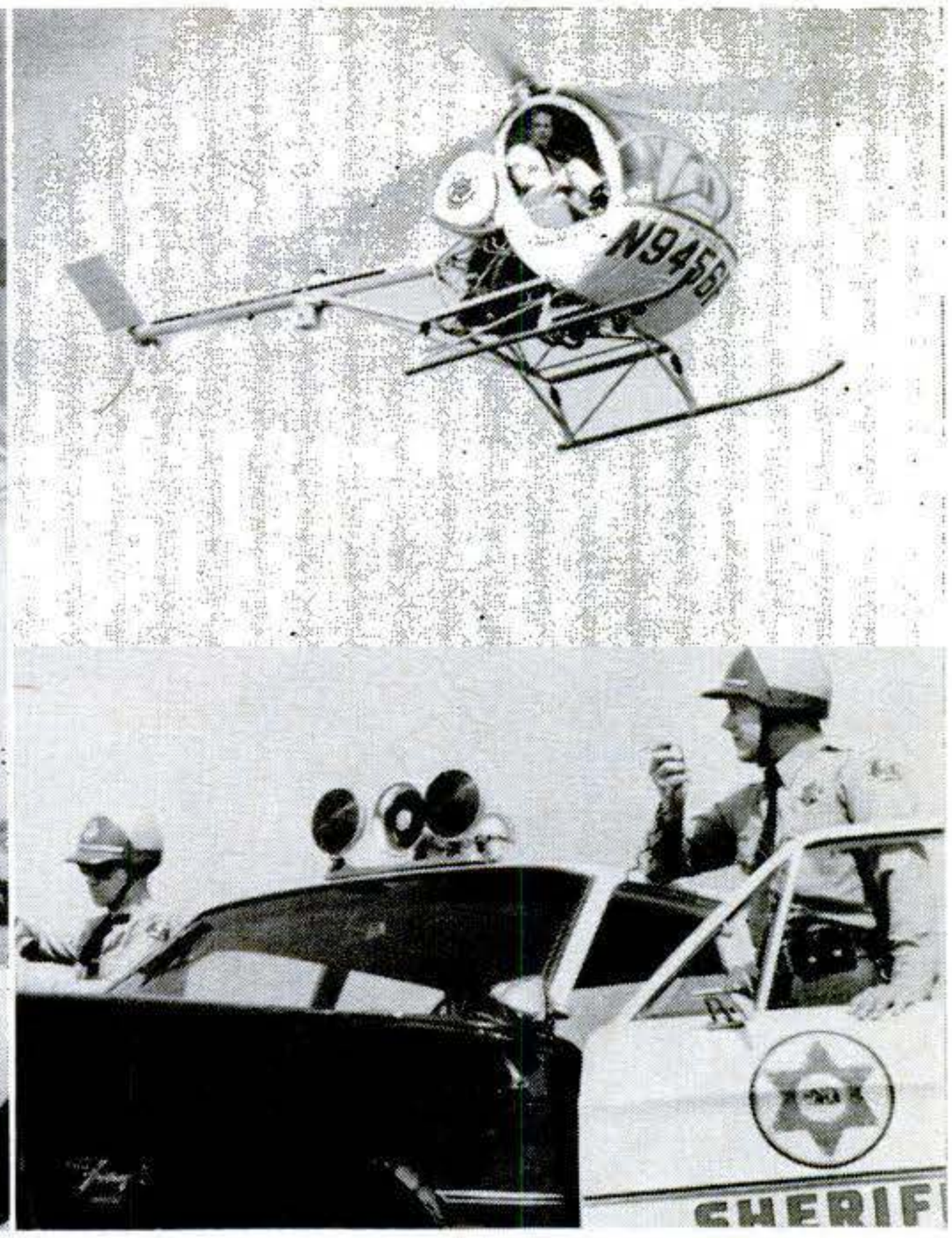
Powerful searchlight can light up a huge area below.



Car on ground, copter in air, show close teamwork.

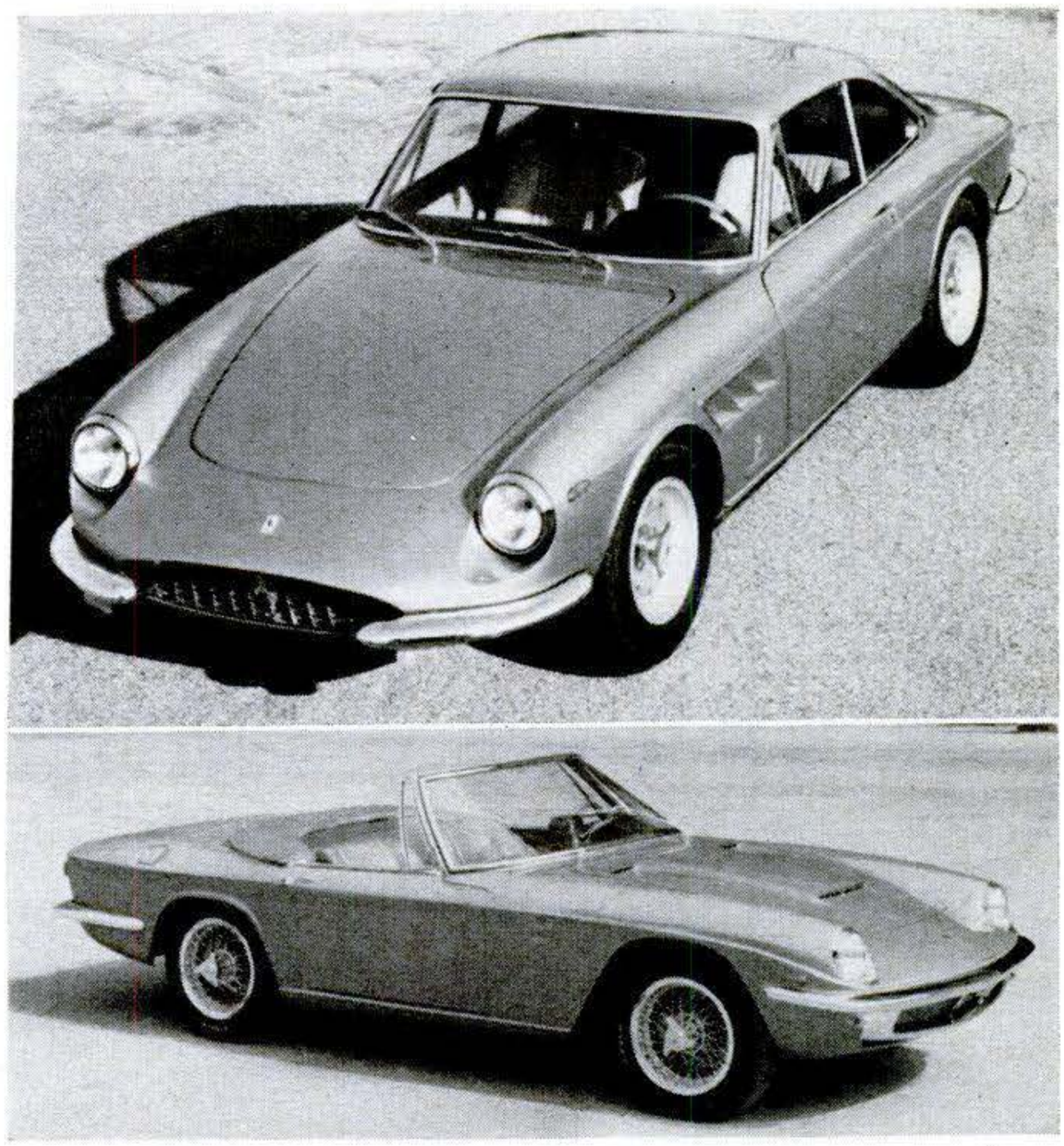
Ferrari and Maserati show new models

Unlike Detroit, the Italian makers of Ferrari and Maserati cars don't have annual model changes.

Here are the latest additions: Ferrari's 330 GTC and Maserati's "2 Posti" (two-seat) Spyder. Prices are around $15,000.

The Ferrari has a 300-hp. V-12 engine, five-speed manual transmission, disk brakes on all four wheels. and all-independent suspension.

The Maserati has a six-cylinder engine with dual overhead camshafts and fuel injection. It puts out 235 hp. Standard transmission is a five-speed manual ZF. Automatic is optional.



Ferrari 330 GTC (top) and Maserati "2 Posti" Spyder are latest sleek models from Italian makers. Both cars have disk brakes on all four wheels.

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This 140-m.p.h. Test Car Is Driven by Remote Control

Problem: to test experimental tires without risking drivers' lives. Solution: radio-controlled test cars.

By **JIM DUNNE** / *PS Detroit Editor* DRAWING BY RAY PIOCH

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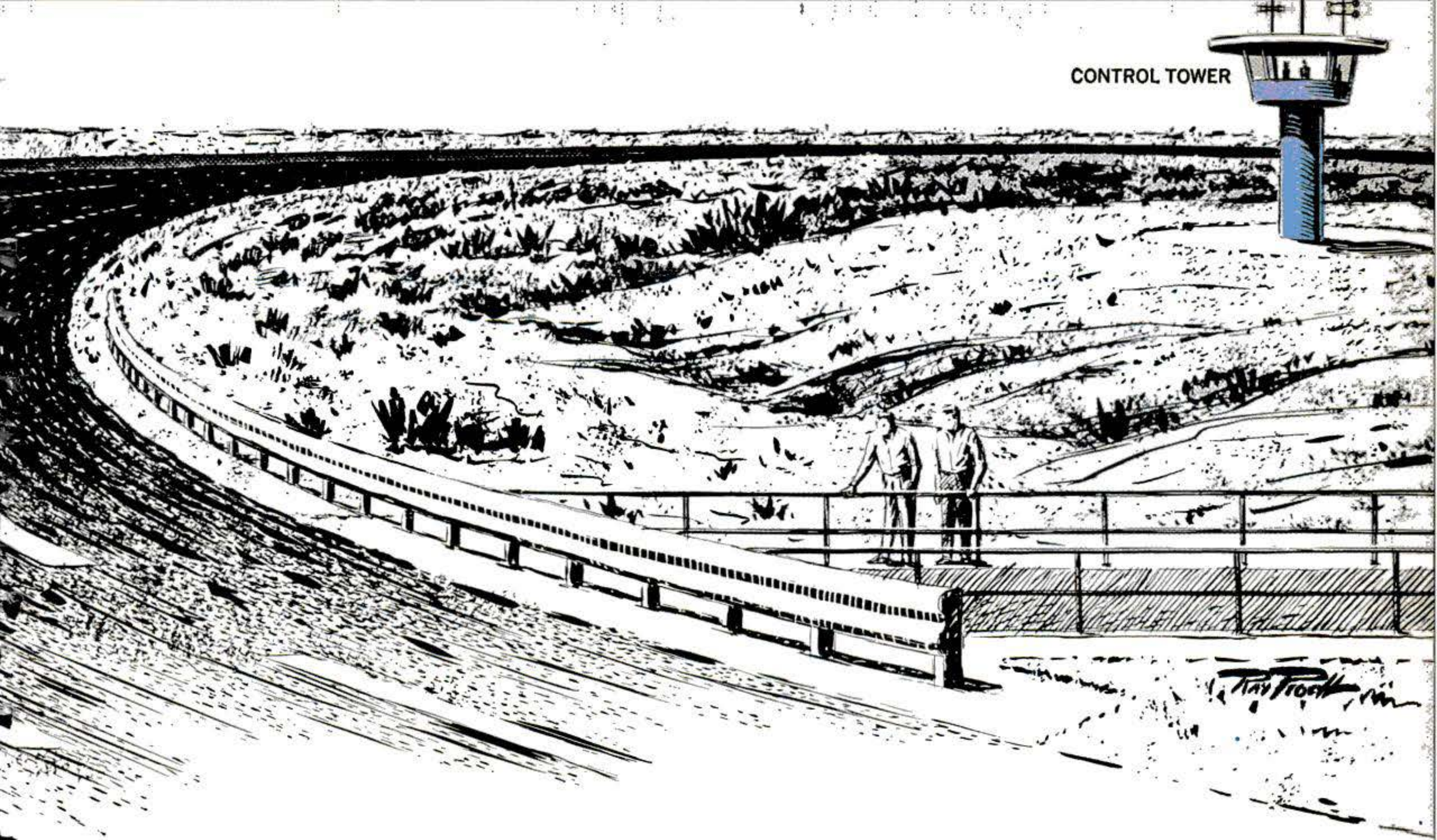

The automatic steering system goes into operation only when the test car is high up on the bank of the track, and its guidance boom is positioned over the track's guidance cable.

By the end of next month, a two-ton automobile, off a Detroit assembly line, will be coursing around a five-mile, circular test track near Laredo, Tex., without a soul—inside the car—at the controls.

The car will literally steer itself around the track as its guidance boom, extending two feet to the right of the front bumper, follows the path of an electronically charged cable that surrounds the track. A servomechanism linked to the car's steering gear automatically adjusts the angle of the front wheels so that the edge of the boom—which contains an electronic pickup—is always directly above the guidance cable.

Inside the car an elaborate radio-control system, monitored by technicians in the track's control tower, will manipulate the car's throttle and brake linkages. A telemetering transmitter will send back to the tower continuous data on engine condition, vibration, fuel supply, and the running temperature of the tires under test.

This, the world's first high-speed track equipped to test tires at speeds up to 140 miles an hour without risking a driver's neck, is the laboratory of the U.S. Rubber Co. In the coming months, the test speeds could rise to 160 m.p.h.

With legal speeds on U. S. superhighways creeping up, the rubber companies are looking to the time when tires must be sturdy enough to run at sustained speeds of 100 m.p.h.

Lab tests cannot duplicate the stresses and heat buildup tires undergo on the road. New tires must be proven in actual driving situations.

Fifteen vehicles are being set up by race-car builder Mickey Thompson to run the high-speed tests. Four-hundred-cubic-inch-plus engines will give each of the cars a 160-m.p.h. capability.

What would happen if something went haywire? A car out of control at 140 m.p.h. is a disaster looking for a place to happen.

U. S. Rubber engineers say that nothing serious should occur if all control systems, and their fail-safe backup systems, fail at the same time. Because of the design of the Laredo circle, there is little likelihood of a car running off the inside of the track until it is going less than 60 m.p.h. That's the "neutral" or hands-off speed of the slowest lane. For 50 yards inside the track, an infield area, completely free of obstructions, will be provided. The top of the banking is so shaped that the test cars, at their scheduled speeds, won't reach it—they'll stay in the "bowl."

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Here is one of MerCruiser's four new stern-drive packages for '67. This 160-horse

OUTDRIVES: The 'In' Way to

No matter what the size of your boat, there's an outdrive power package tailored to fit

By **JIM ROE** / *PS Boating Editor*

These hustling hunks of power are the mating of inboard engines with outboard drives. The vigorous hybrids are the big news in boating. The horsepower range is now so complete there's one for any boat from 14 feet up. Here's what's new in outdrives for 1967:

Kiekhaefer has four brand-new ones; each model offers nine horsepowers ranging from 60 up to 475. Also new is the MerCruiser 80. This 80-hp. four-in-line is a Kiekhaefer-modified Renault. Aluminum block, head, and manifolding keep total weight to only 326 pounds.

The 120- and 160-hp. MerCruisers have a new power-trim hydraulic system which tilts the drive unit to plane or trim the boat even at full throttle. A pushbutton positions the drive unit.

Chrysler's nine inboard/outdrive models for '67 range from 80 to 290 hp.

Smallest is a 80-hp. four-cylinder weighing 350 pounds. It's for 14- to 16-foot boats. Hydraulic lift is optional.

Also new is a Chrysler-Volvo that develops 120 hp. at 5,500 r.p.m. with regular gas.

For large houseboats and cruisers, there is the new Chrysler 260-hp. hydraulic-drive, 90-degree inboard-outdrive. It's a 383-cu.-in. V-8 engine with a 1:1 hydraulic reverse gear. It has gearshift, outdrive tilt up, and power-prop steering.

Gale Products Div. of Outboard Marine Corp. added two new OMC stern drives. One, a Buick V-6, is a 224-cu.-in., 150-hp. model with new intake manifolding and a two-barrel carburetor to increase torque output at low r.p.m. Result: faster acceleration and more economical cruising.

One new OMC drive is a 180-hp. V-8 for houseboats and large runabouts. Other

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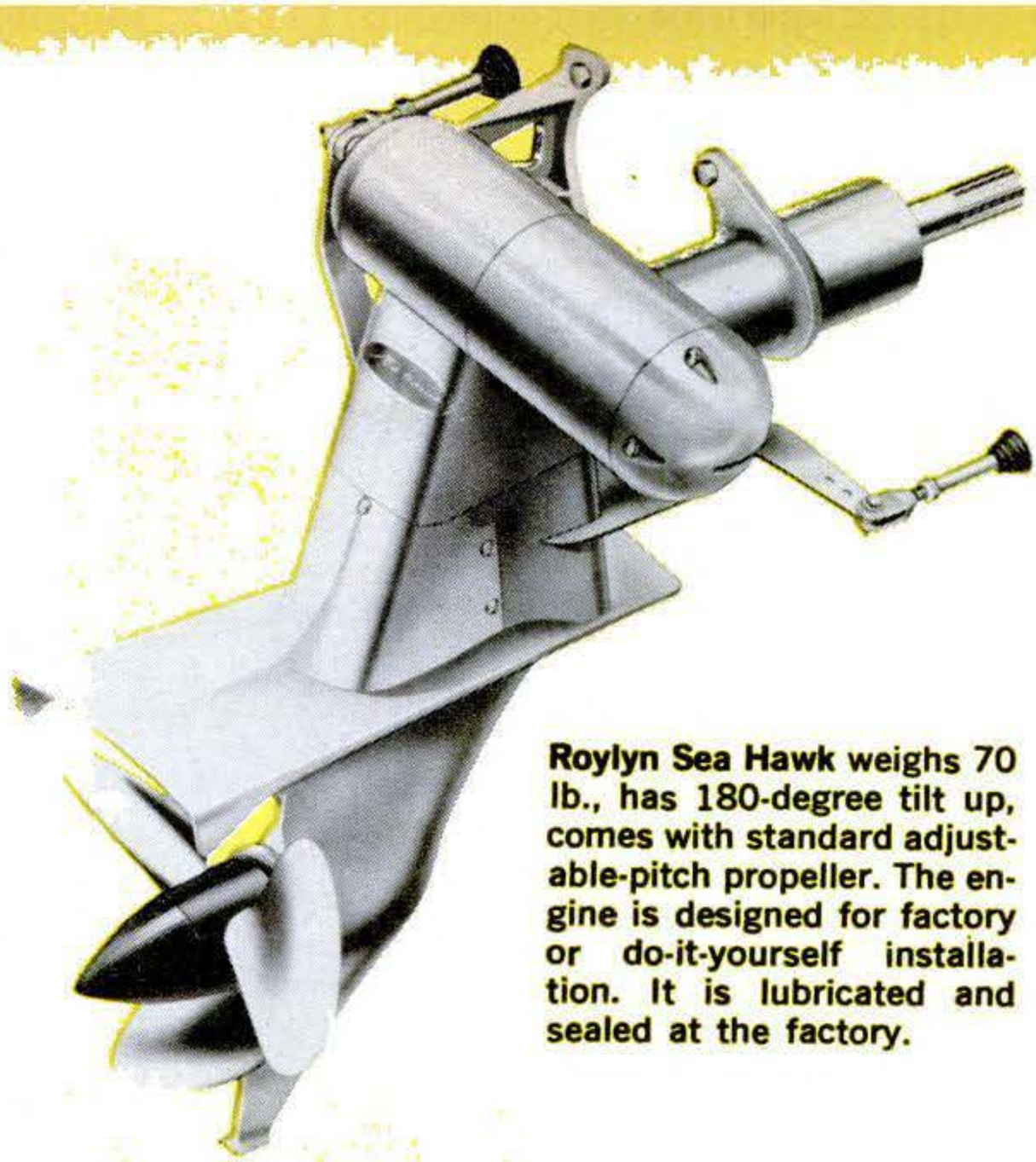
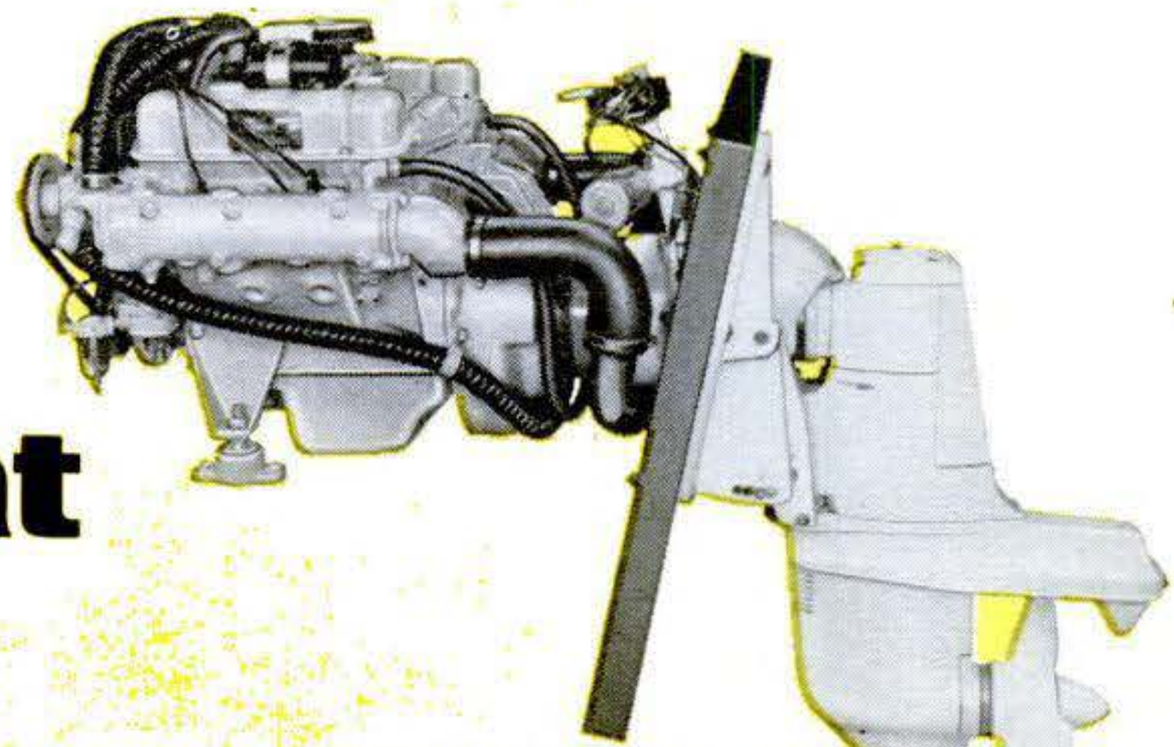
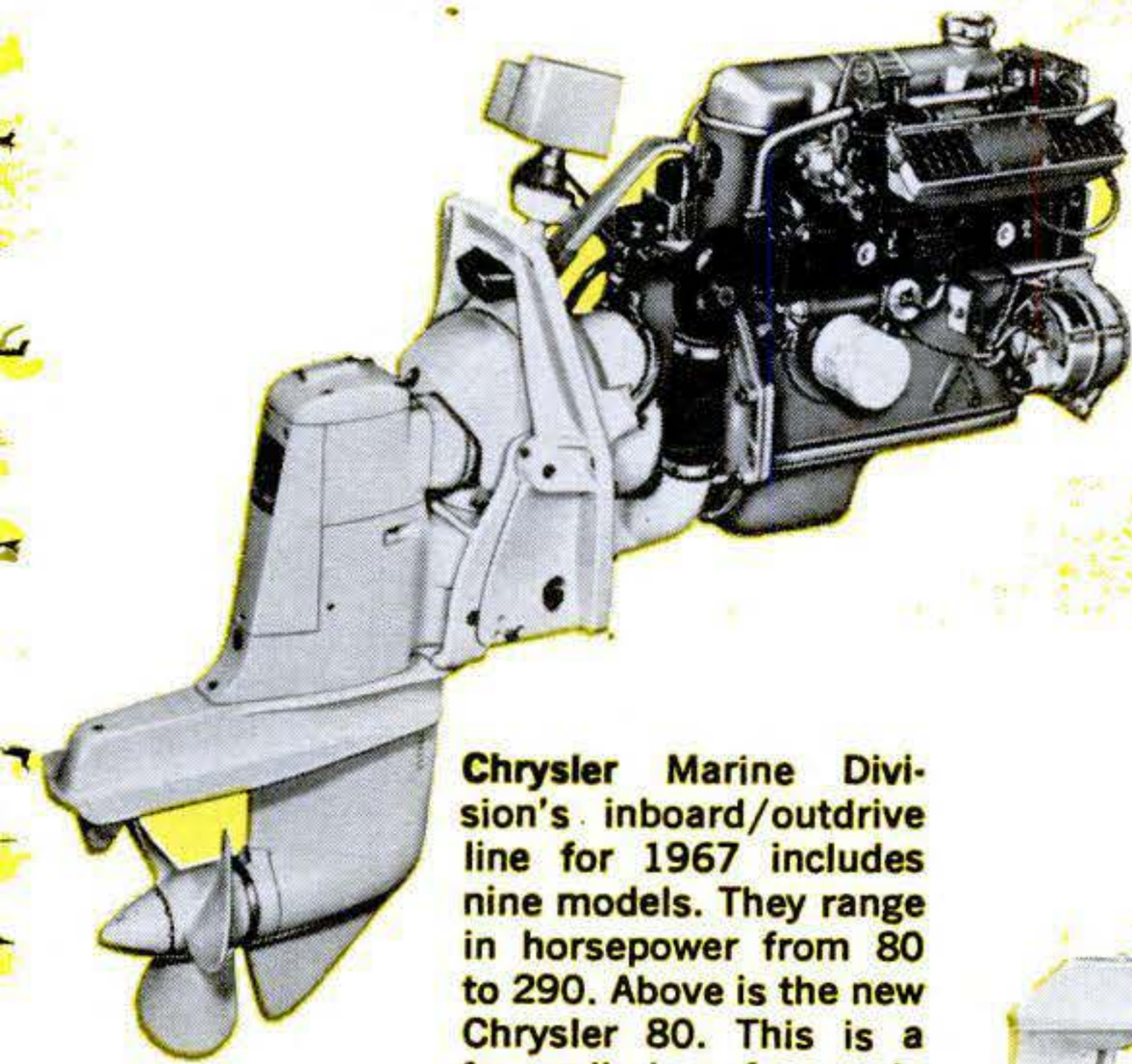
MerCruiser has a six-in-line engine.



Roylyn Sea Hawk weighs 70 lb., has 180-degree tilt up, comes with standard adjustable-pitch propeller. The engine is designed for factory or do-it-yourself installation. It is lubricated and sealed at the factory.

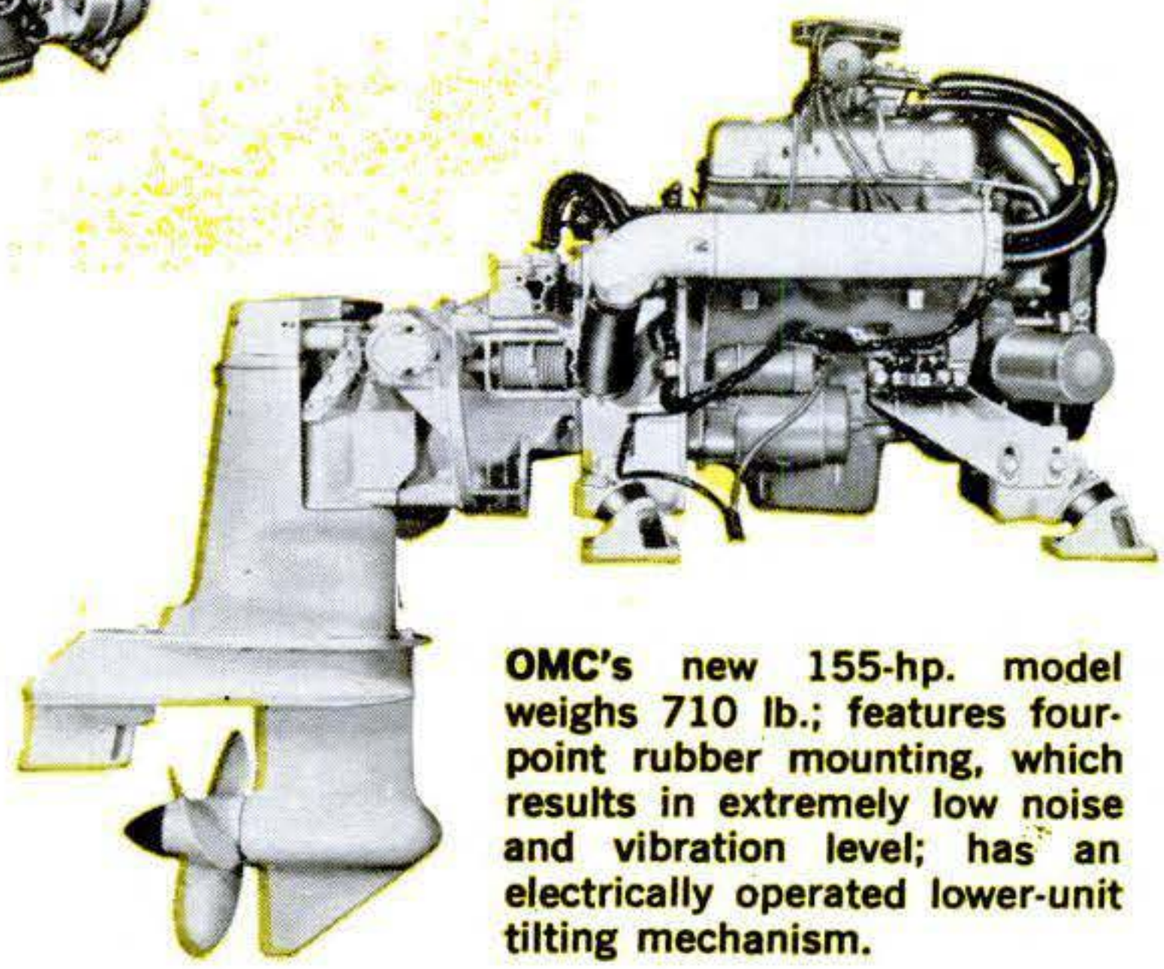


Propel a Boat



Universal's Super Sabre V-6 develops 155 hp. Here it is teamed up with a new Volvo 200 inboard/outboard. Electric tilt lifts outdrive 65 degrees out of the water.

Chrysler Marine Division's inboard/outdrive line for 1967 includes nine models. They range in horsepower from 80 to 290. Above is the new Chrysler 80. This is a four-cylinder, four-cycle unit, which weighs only 350 lb., develops 80 hp.



OMC's new 155-hp. model weighs 710 lb.; features four-point rubber mounting, which results in extremely low noise and vibration level; has an electrically operated lower-unit tilting mechanism.

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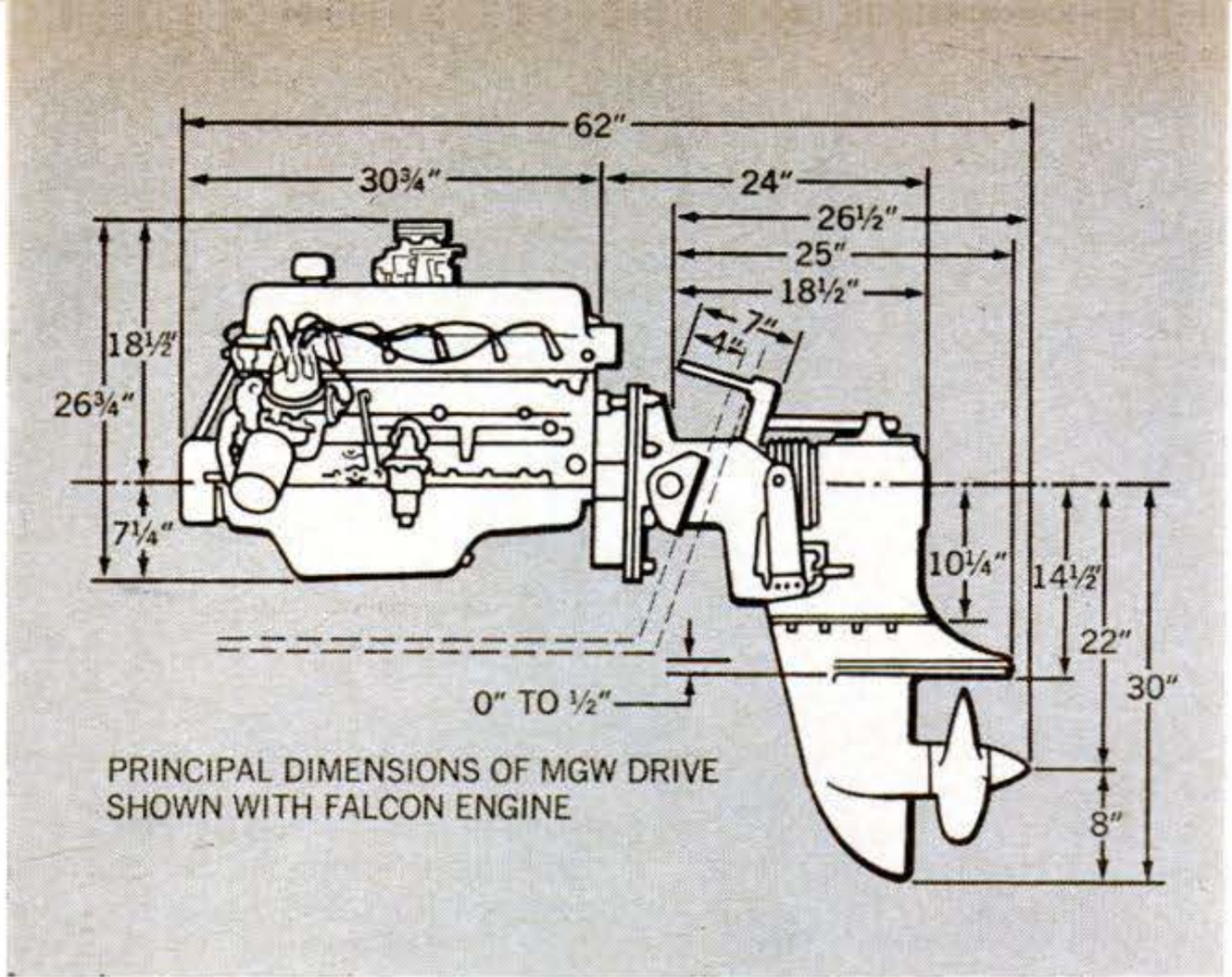
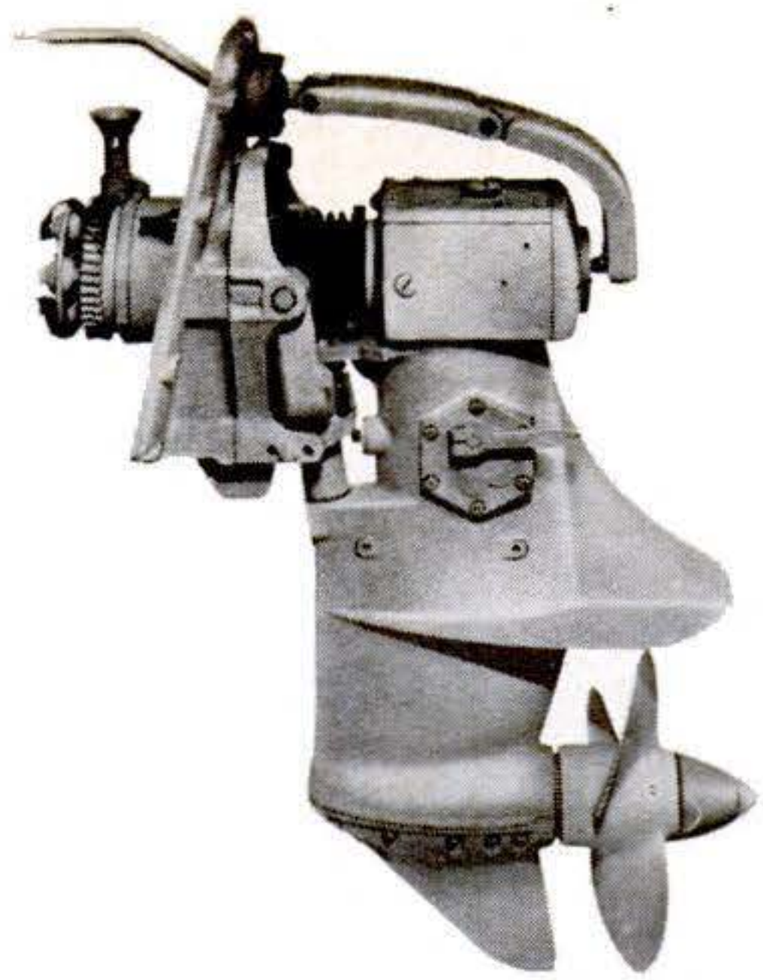
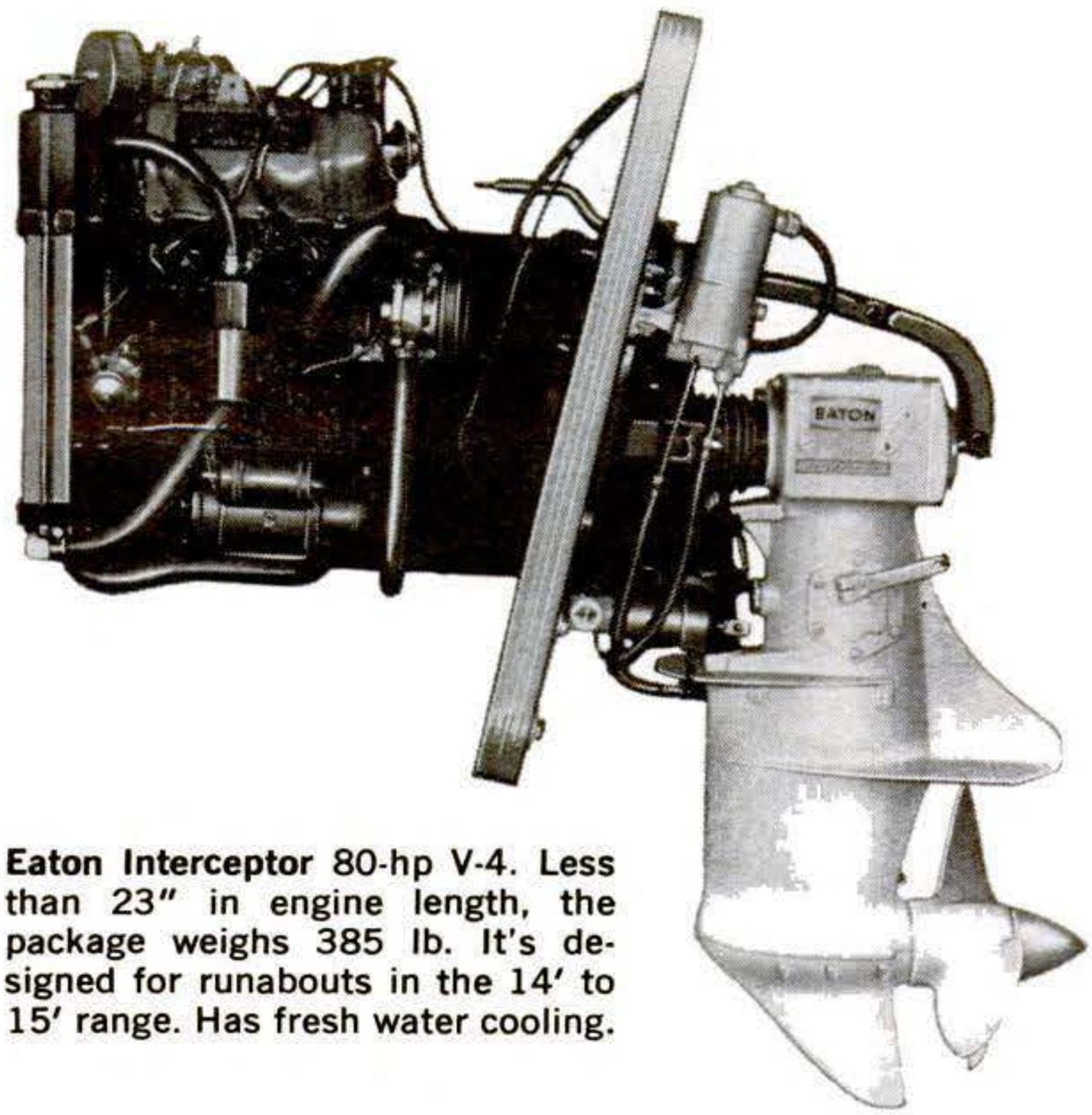


PRINCIPAL DIMENSIONS OF MGW DRIVE SHOWN WITH FALCON ENGINE

MGW drive made by Muncie Gear Works is shown above, coupled to a Falcon engine. The MGW is available with or without an engine. It is designed to be torque-free in any direction.



Perkins Mark II Z-Drive, with worm-gear swiveling mechanism which lifts up the lower end of the unit.



Eaton Interceptor 80-hp V-4. Less than 23" in engine length, the package weighs 385 lb. It's designed for runabouts in the 14' to 15' range. Has fresh water cooling.

OMC stern drives for '67 have horsepowers of 90, 120, and 200.

Eaton Marine has six Interceptor units. New is a husky 250-hp. model based on a 352-cu.-in. engine. Other horsepowers include a V-4, 80-hp. compact; a V-6, 100-hp., and 140-, 165-, and 200-hp. V-8 models.

All Interceptor inboard/outdrive models tilt up to pass over obstructions. The 165-hp. and the 200-hp. models have a 65-degree electric lift as standard.

Universal, builder of the Atomic Four, now offers a Super Sabre V-6. It's a 155-hp. engine teamed to Volvo inboard/outdrive. Its 600-pound low-profile engine is designed for runabouts and medium cruisers.

Stern Drive Corp.'s unit uses gas engines of 180 hp. or diesels of 100. Called the 175, it uses a two-inch wide chain instead of gears, and it eliminates steering torque. Engines can be mounted flush at the transom, or up to nine feet forward if desired for stability.

A new lightweight outdrive, the MGW, by Muncie Gear Works comes with or without engine and in ratings up to 100-hp. It weighs only 90 pounds. Steering is torque-free.

Stokes Marine teamed a 155-hp. Buick V-6 with a Muncie FD 500 Flexi-drive. And they offer a 90-hp. Chevrolet II engine coupled to Muncie's MGW outdrive.

Stern-drive units for high-torque diesel engines are offered by Perkins Engines. Called the Mark II Z-Drive, it has a jointed tiller arm that pivots to parking position.

It is offered with a four-cylinder 50-hp. diesel and weighs less than 500 pounds.

Roylyn's stern-drive Sea Hawk is 70 pounds of high-strength aluminum alloy, designed for any gas or diesel engine up to 5,000 r.p.m. The drive pivots 180 degrees to put the propeller up for inspection or changing. It comes with a built-in transmission, with simple push-pull forward, neutral, and reverse positions. The propeller adjusts through eight pitch positions.

Outdrives work anywhere. There's even a long-legged one for catamarans and a small jet unit for canoes. In 1967, a dinghy will be about the only craft you cannot easily outfit with an outdrive. PS

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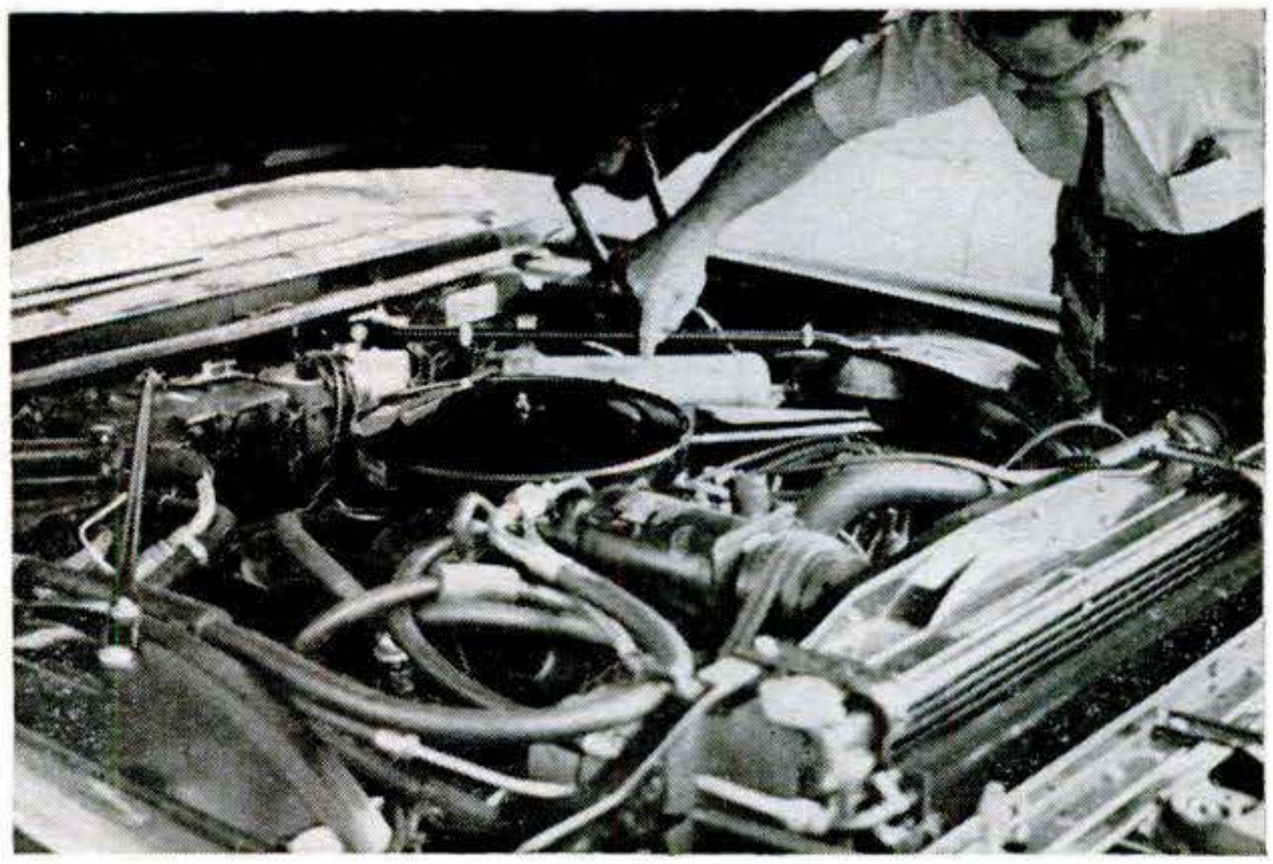
Caddy's New Eldorado Has Front-Wheel Drive



Under the Eldorado hood you'll see more pipes and hoses, pumps and filters than you'd find in a Chinese waterworks.

By naming it Eldorado, Cadillac kills two birds with one stone. GM's top division revives one of its old dream-car, and former top-line, titles, and gives its front-drive model a name to rhyme with Toronado. The Eldorado shares most of the drive-train and suspension parts with the front-drive Olds, but has many Cadillac refinements and uses Cadillac's 340-hp. 429-cu.-in. V-8 engine.

Its outstanding refinements are automatic leveling and variable-ratio steering. The Eldorado has softer rear springs than the Toronado to soak up some of the low-speed ride roughness. Soft springs would normally cause all kinds of trouble—the tail end would drag when carrying a full load of luggage, or the springs would have to be so high that the car would look awkward when unladen. Cadillac found the answer in Delco's compressed-air-operated leveling system. Load up the car and the shock absorbers lift the rear end to carry the extra weight. Unload, and the car stays level.

Front drive provides outstanding benefits to a car of this size, especially in combination with the variable-ratio power steering. It has very high handling precision, though it's by no stretch of the imagination a sports car. "We call it a super-luxury personal car," a Cadillac man told me.

All its accessories, such as Climate Control, automatic leveling, power steering, and power brakes, build up an enormous heat load on the engine. To keep it from overheating, the radiator is fitted with a special sensor valve that automatically switches distributor vacuum when the temperature reaches 240 degrees. The engine then speeds up another 50 r.p.m. and things cool off.

The Eldorado is built on a 120-inch wheelbase (Cadillac's shortest in modern history), and overall length is 221 inches. It stands 53.3 inches tall and 80 inches wide, weighs 4,700 pounds. Performance is somewhat sedate—about 12 seconds from zero to 60 m.p.h.—*Jim Dunne.*

Eldorado is three inches shorter than regular Cadillac, but its hood stretches almost six feet.

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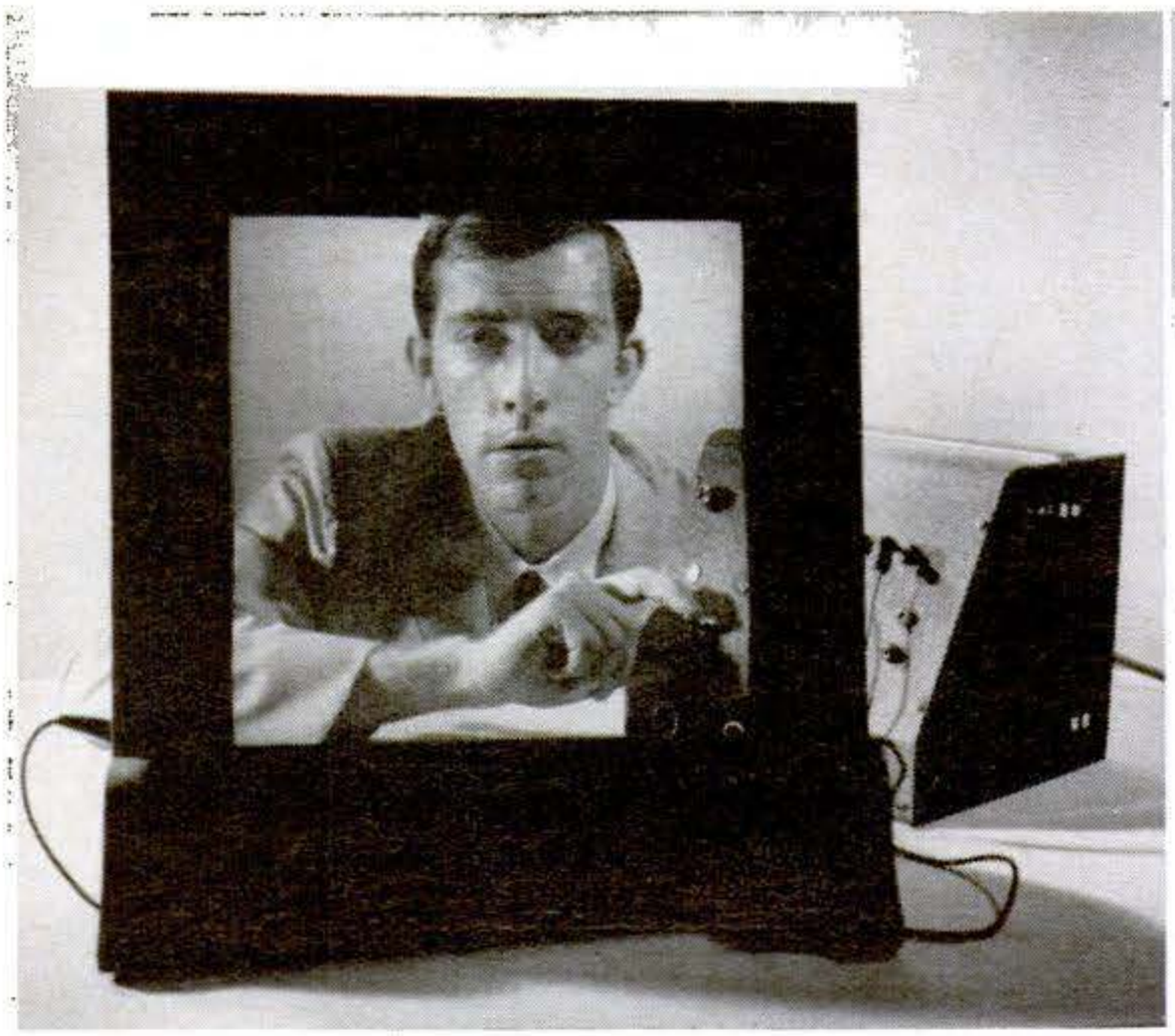

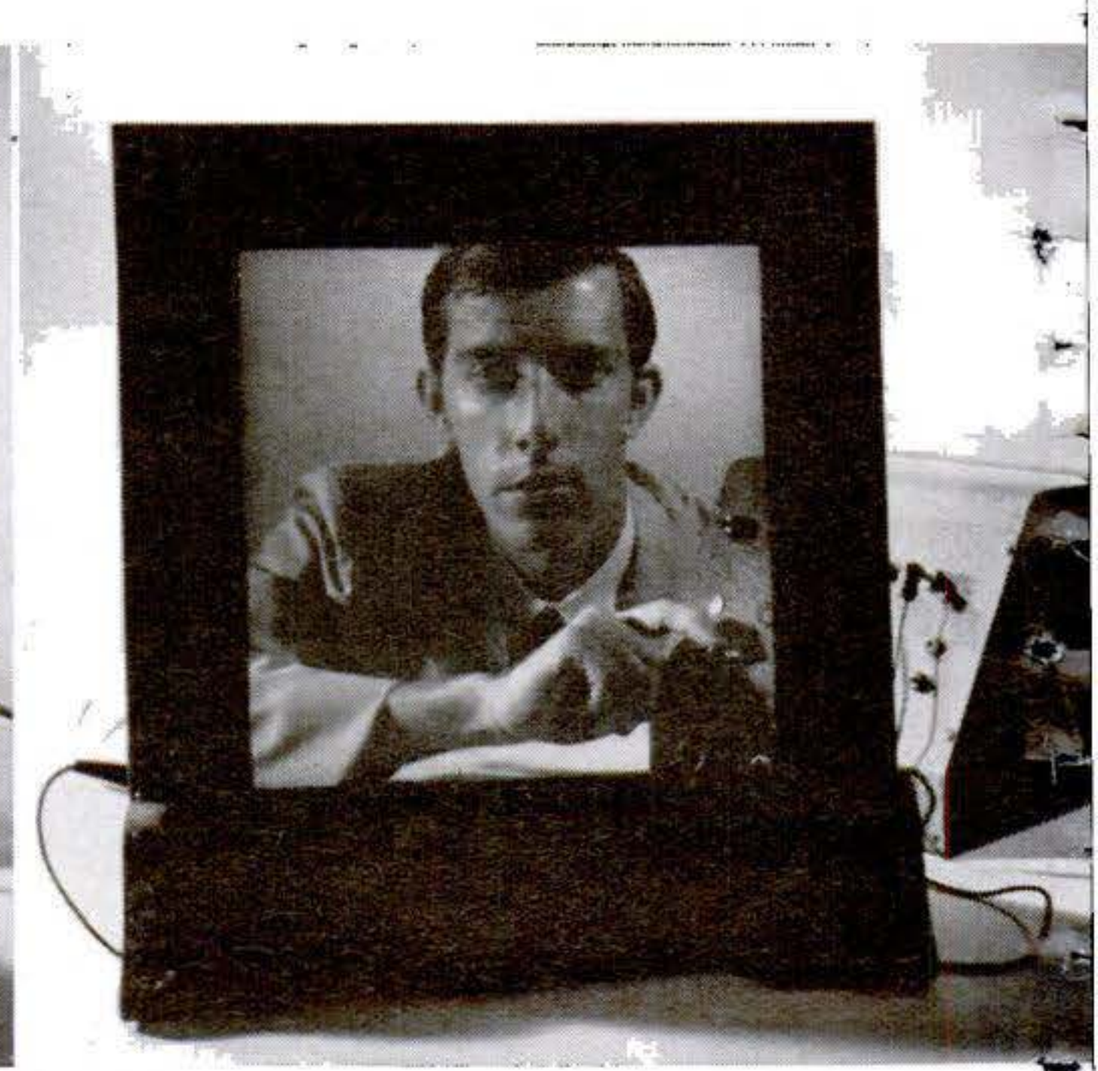

Man sitting behind window is clearly visible as oscillator housed in cabinet applies 300 volts at 20 khz to transparent conductive coatings, sandwiched between pieces of glass, to make window clear.

The amazing windowpane that goes

Picture windows, and even entire glass-exterior buildings, can now go from transparent to opaque—or any shade in between. A single window-control knob is used like a light dimmer to shut out glaring sun, make the room dark for sleeping, or let in light in the morning. These same windows could also cut heating and cooling bills because they can be designed to absorb the heat of the sun or reflect it, keeping the house at a constant temperature.

The amazing windows, a blend of glass and electronics, are the invention of Alvin M. Marks, a scientist in the fields of electro-optics and light polarization. They're under development at Research Frontiers, Inc., Farmingdale, N.Y.

Two major advances make the windows possible: whiskers of metal with a nearly uniform length of one micron, and a transparent coating that conducts electricity. The "whiskers" are dipoles, acting in the same way at light frequencies as dipole TV antennas act at TV frequencies.

When an electromagnetic field is applied to the two conductive coatings on either side of the liquid that holds the dipoles in suspension, they align themselves with ends perpendicular to the window, permitting light rays to pass. When the field is removed, Brownian movement (random movement of the dipoles due to the impact of molecules of the fluid) causes the dipoles to scatter at random. The scattered dipoles absorb the

Gun launches rocket to high altitude

The solid-fuel rocket being loaded into the breech of the standard Army 155mm field gun at left can be launched to an altitude of 125 miles, experiments by the Lockheed Propulsion Co., Redlands, Calif., have shown. A standard powder charge drives the projectile out of the barrel. Once out and on its own, the rocket motor ignites, propelling the projectile seven times as far as a rocket launched by conventional methods.

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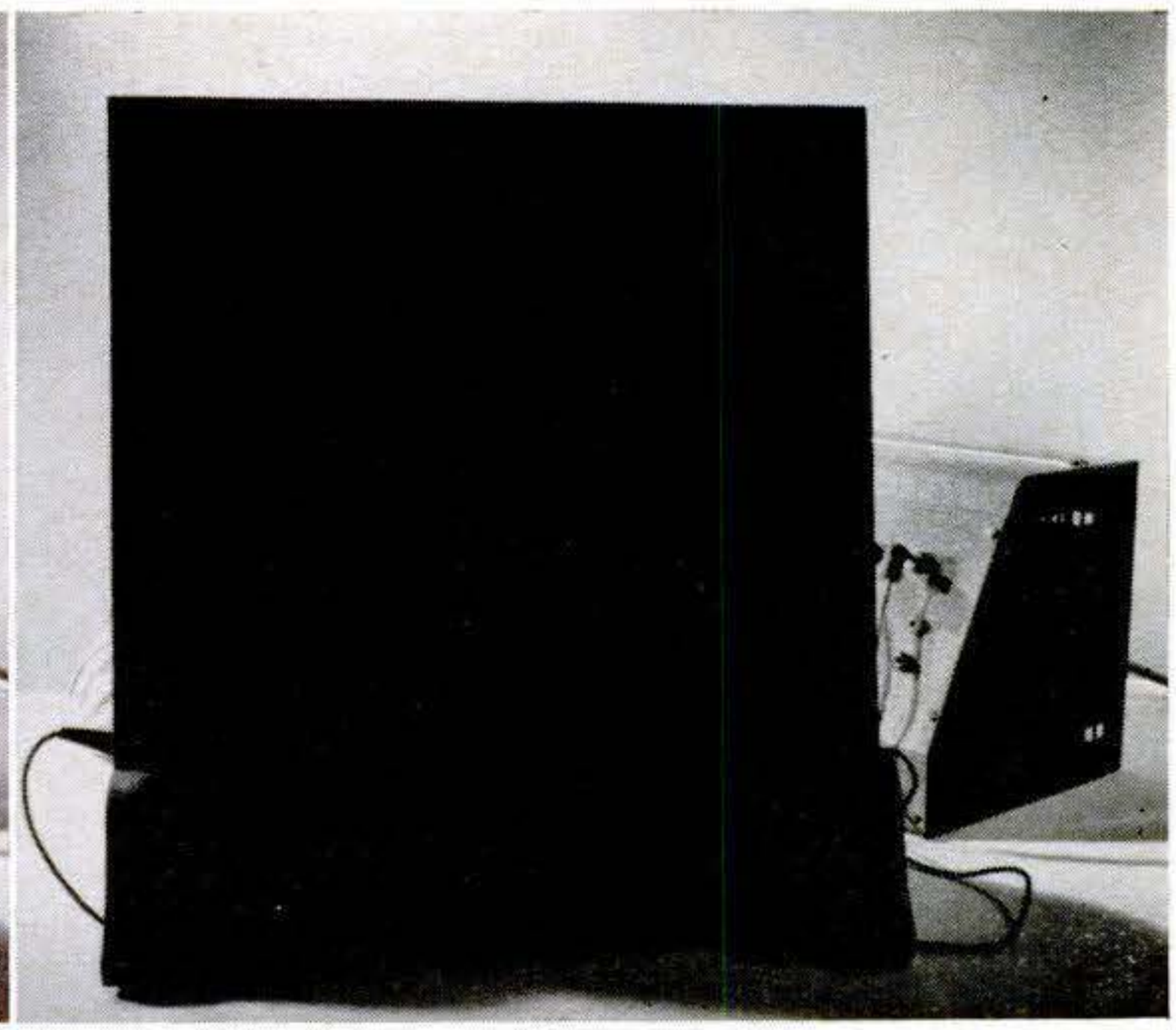
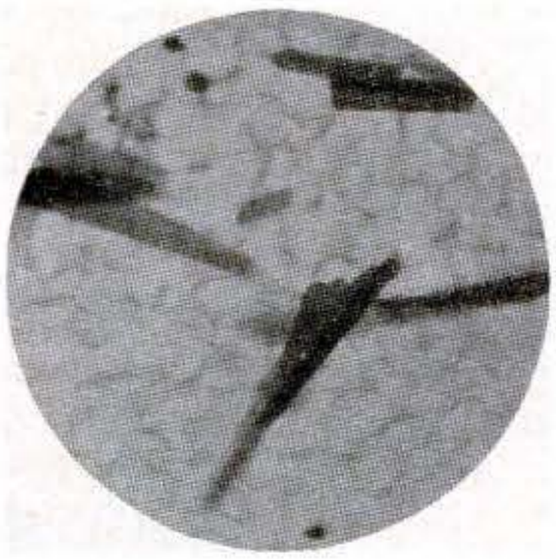


As applied voltage is reduced, the electromagnetic field becomes weaker and the tiny dipoles in liquid suspension begin to scatter. When voltage is cut off, window becomes completely dark (above).

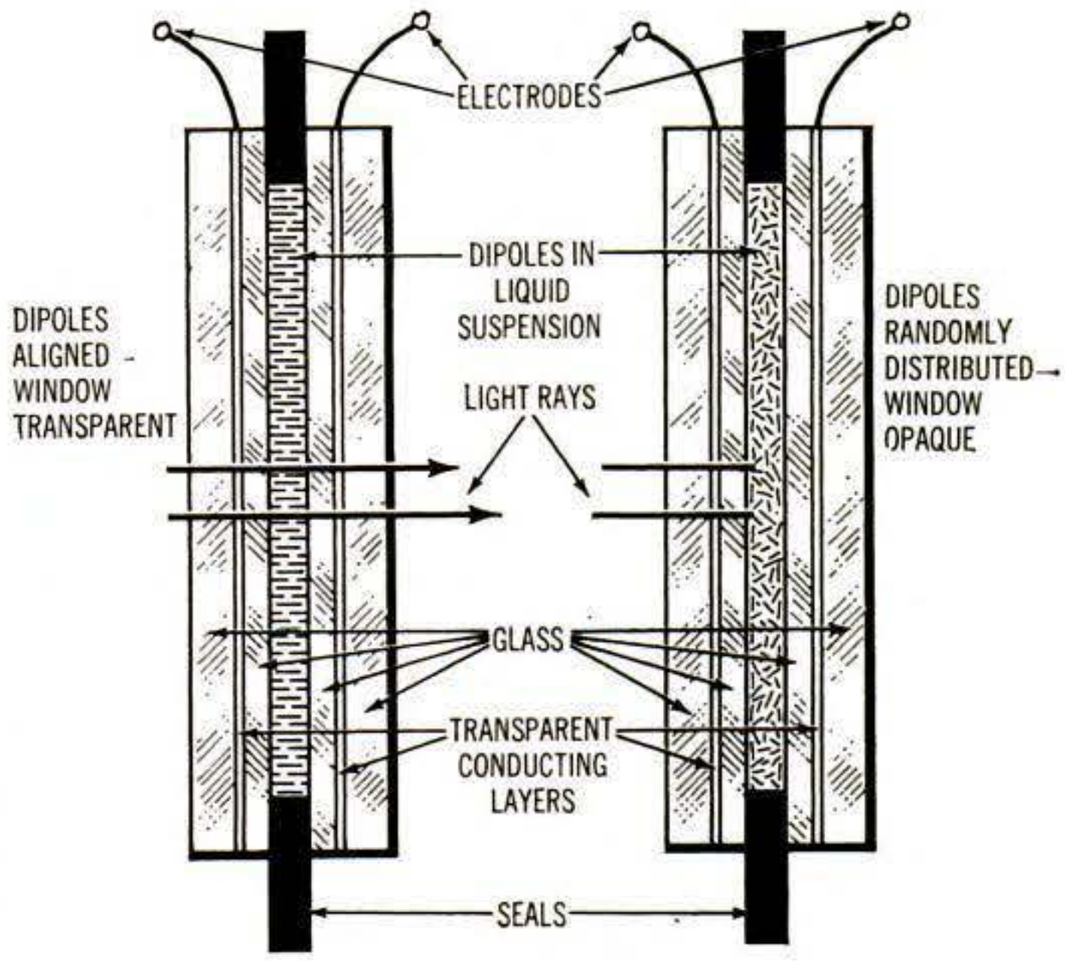
from light to dark

light striking the window, and it becomes opaque.

The electromagnetic field that controls transparency is in the form of a high-frequency AC voltage generated by an oscillator.

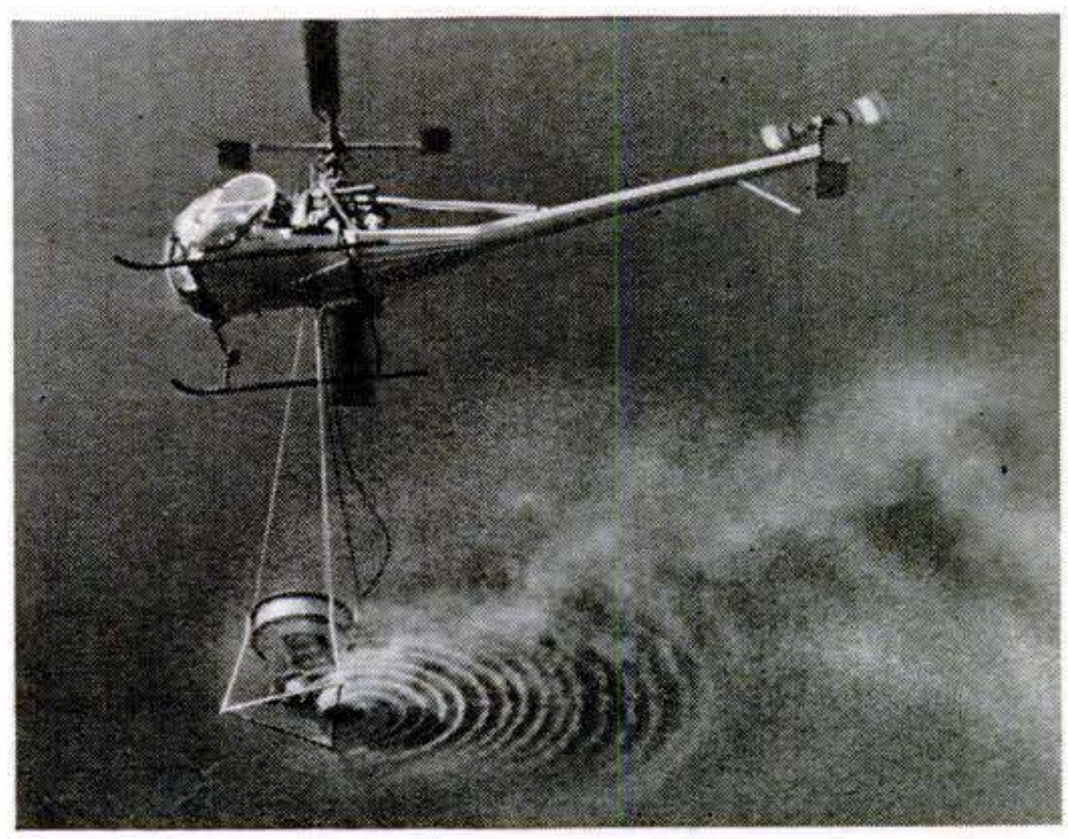


Microscopic dipoles, almost a uniform one micron in length, form basis of window (left). Better techniques will reduce size to 1/5 micron for greater efficiency. Drawing at right shows how windows operate with glass sandwich holding suspension.



Crop spreader hangs below copter

A new chemical spreader is slung from the cargo hook of a helicopter instead of being mounted on the belly and fed from hoppers on the sides. This eliminates the possibility of damage to the airframe or engine by corrosive materials. The Pace-Spreader spreads up to 800 pounds of dry chemicals or fertilizer a minute from a hopper on the hook directly above it. It's made by Evergreen Helicopters, Inc. McMinnville, Ore.



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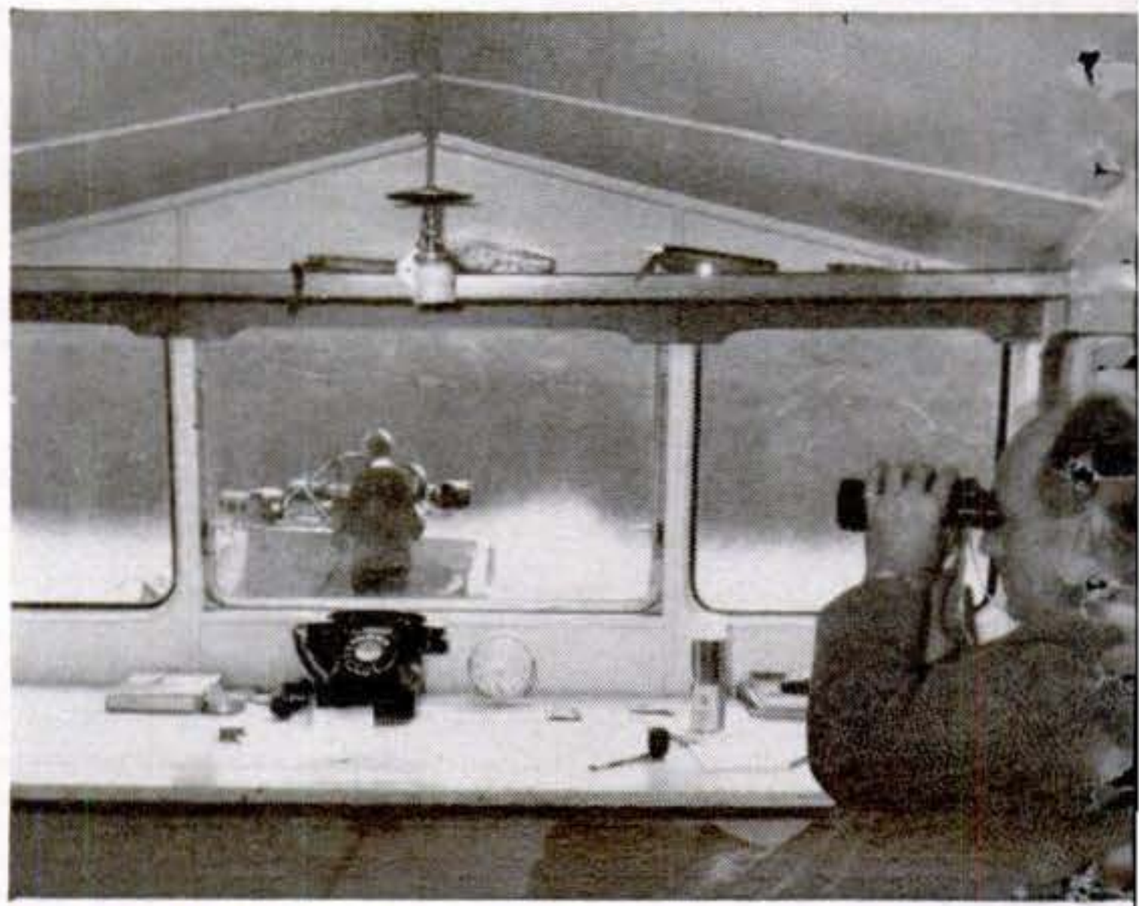
New Evidence Spurs Hunt

There's really something huge, "probably" alive, in Scotland's biggest lake, report RAF photo experts—and searchers aim to trail it with scientific gear

By DAVID SCOTT
PS European Editor

Home of supposed colony of monsters, 24-mile-long Loch Ness in Scotland is mostly more than 700 feet deep. Once it was arm of sea, whence the creatures are thought to have come.

LOCH NESS, SCOTLAND.—It was the biggest slug I'd ever seen, five inches of black creepy-crawly. I'd nearly stepped on it as I climbed over a grassy rain-soaked hill above Scotland's longest and deepest lake. "They grow big here," my companion observed. "And our quarry," he added, "may be the



At monster hunters' headquarters beside Loch Ness, lookout David James views a distant ripple through binoculars, while Clem Skelton mans cameras, seen through window and in photo at right.

for Loch Ness Monster

A startling close-up of Nessie? Peter O'Connor, English taxidermist, says he took this flash photo of creature at 25-yard range with simple Brownie camera, early in spring day of 1960. Monster hunter Tim Dinsdale backs claim that picture is authentic.

granddaddy of them all—a giant sea slug."

My guide was Clem Skelton, resident technician of a group that is hunting the celebrated Loch Ness Monster. Eyewitnesses' accounts describe the creature as up to 50 feet long, with a serpentine neck and head, a kangaroo tail, and a back like a capsized boat. By various speculations it might be an enormous sea slug, as Skelton suggested—or a reptile akin to prehistoric ones, or something else again.

"All I know is that it's big," says Skelton, a free-lance film director and a dedicated believer who has seen the aquatic what-is-

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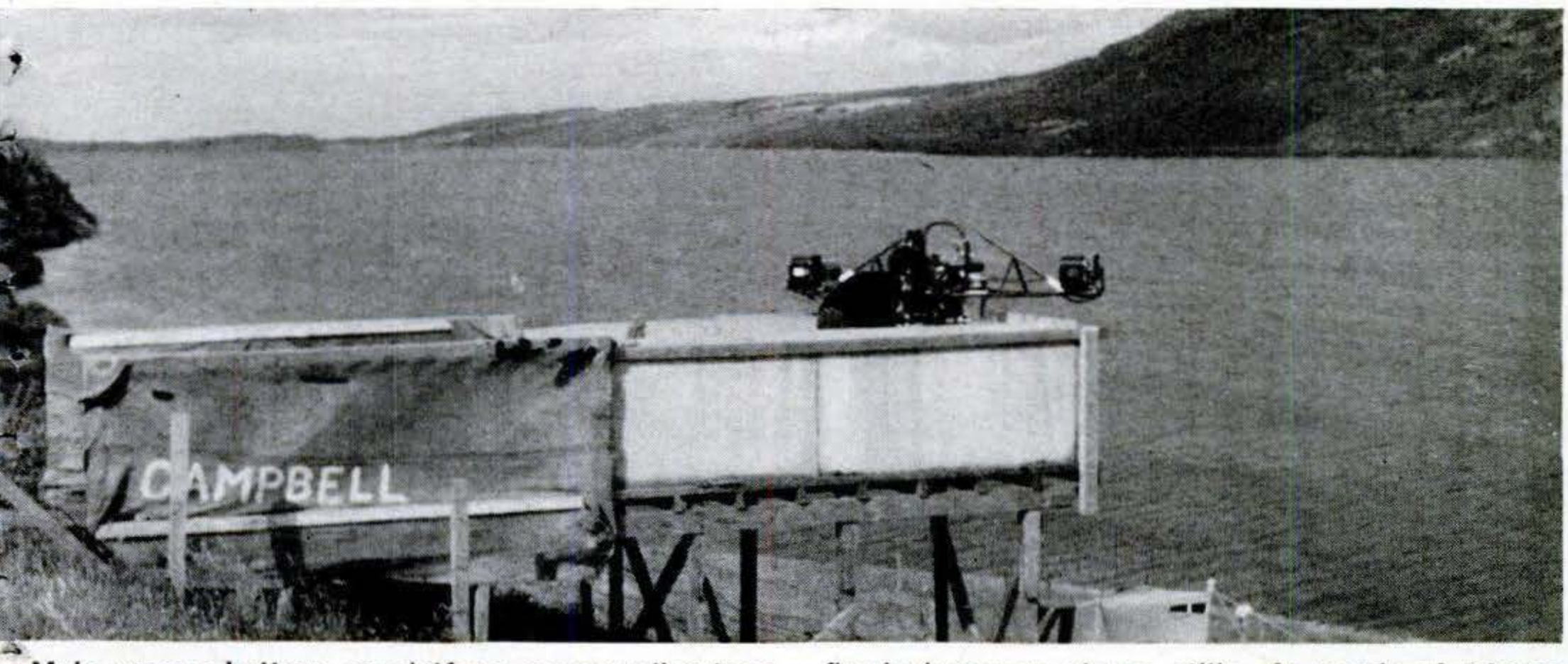
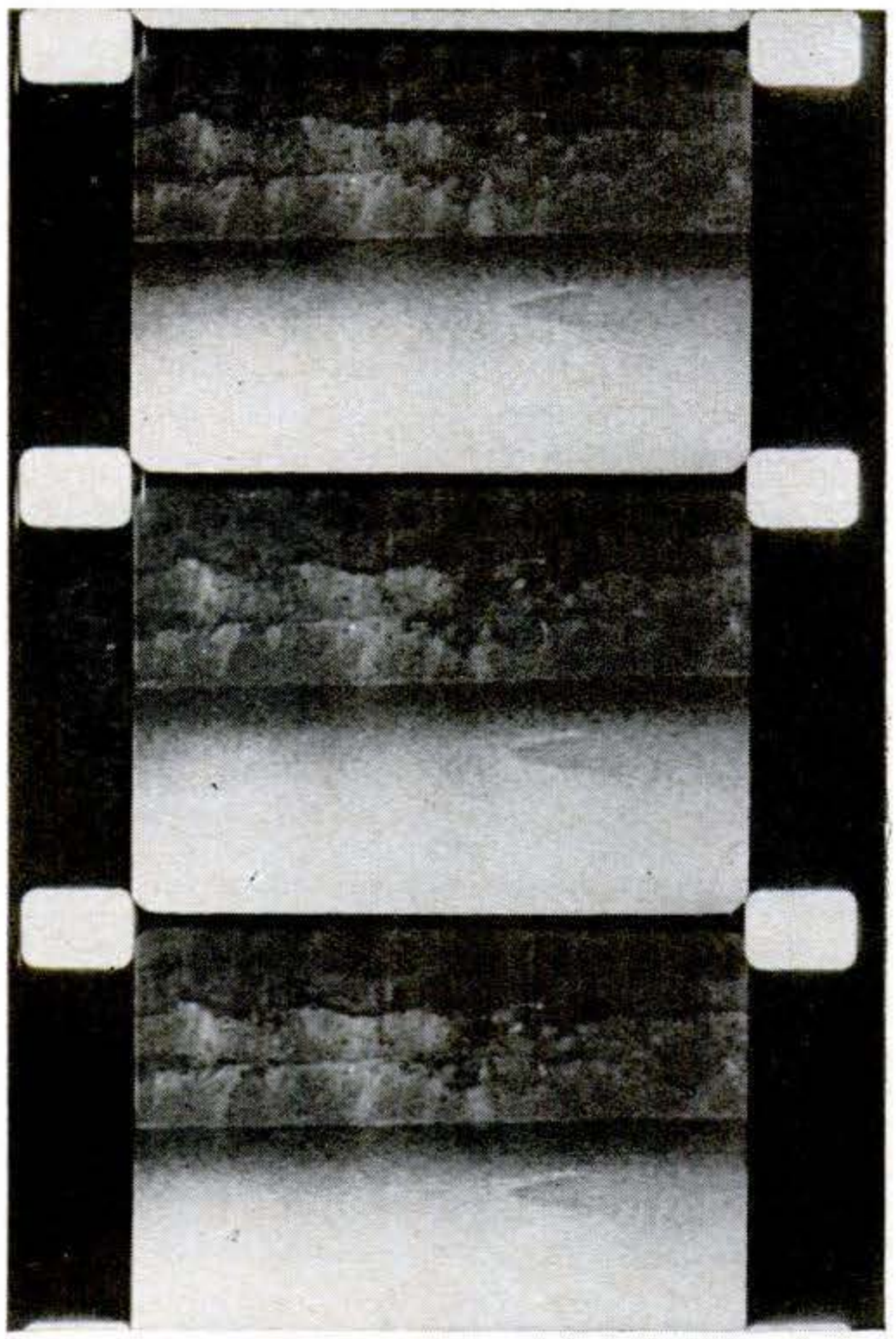


Main camera battery, on platform commanding long view over Loch Ness, consists of 35mm movie camera with hefty 36-inch telephoto lens, flanked by pair of aerial-survey cameras with 20-inch lenses for five-inch-square stereo stills. At touch of trigger, battery-powered cameras operate simultaneously, the still ones making a shot every 10 seconds. Hand-cranks pan and tilt all cameras together.

it six times, once at midnight—"a huge hump surrounded by boiling foam"—from only 15 yards. According to the belief of the monster hunters, the landlocked lake is inhabited by a colony of the creatures—rather than a single one long-lived and active enough to give rise to more than 30 years' reported sightings.

Loch Ness's storied monster has long been widely regarded as a myth or a hoax—and ignored by scientists as "impossible" and unworthy of serious attention. Until early this year, that is.

The new evidence. Then a Royal Air Force photo-intelligence unit, as an operation exercise, studied a 16mm film of the "monster" taken in 1960. These photo experts were of the Joint Air Reconnaissance Intelligence Center (JARIC), the crack outfit that analyzes long-range aerial photographs and detected Germany's secret buzz-bomb bases during World War II.



There goes the monster! This is piece of historic movie film, giving distant view of Nessie and its curving wake, that RAF experts studied. What it shows, their 1966 report says, is probably an "animate object" with a body five to six feet thick.

They concluded that Loch Ness holds some enormous "object," probably alive.

The film was made by Tim Dinsdale, a wartime pilot who is now an aeronautical engineer and one of the group on the trail of "Nessie." On the last day of a six-day vigil at Loch Ness in April, 1960, he was driving slowly along a cliffside road 300 feet above the glassy black water, near the lakeshore village of Foyers. Scanning the surface, he spotted a reddish-brown hump-backed object about 1,300 yards away, motionless and apparently floating.

What the camera saw. As he hurriedly stopped his car and grabbed his camera, the oval shape began moving toward the far shore, rippling the water with a bow wave. Elated, Dinsdale filmed what he was sure was the back of a huge submerged animal. The creature swam away in a slow zigzag course, disappeared below the surface, and turned left along the opposite shore, throwing up a tremendous wash whose rhythmic bursts of foam suggested paddle strokes of great power. In 40 feet of film, Dinsdale captured the evidence.

Next day, shooting from the same spot, he filmed a 14-foot motorboat steered by a friend along the course the aquatic animal had taken. This provided a reference with which to compare the creature's size, speed, and wake.

Later that year, Dinsdale's film of the "monster" was shown on BBC television, and subsequently on TV programs all over the world. Letters poured in, and previously silent witnesses offered new corroborative testimony. But there the matter rested. Zoologists would not be moved by something that cut across the natural order of things. Officialdom was apathetic about financing or even encouraging a scientific investigation.

So it remained for a small group of amateur naturalists—whose moving spirit was David James, a publisher and at that time a Member of Parliament—to set up, in 1962, a body called the Loch Ness Phenomena Investigation Bureau.

The RAF verdict, four years later, whets their enthusiasm. The group had turned over Dinsdale's film to the photo-recon experts, saying simply, "Here's a film—tell us what's on it." The resulting report is a

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2,000-word JARIC document, couched in guarded military phraseology.

First it cites the known facts, such as the 135mm telephoto lens of the camera, and the height of the sighting point. It states that 20-times enlargements of frames were used for examination, and tells how distance-estimating scales were established along and across the line of sight. The resulting measurements' accuracy is vouched for by the fact that the estimate of the motorboat's length (which was unknown to the photo experts) is only six inches off.

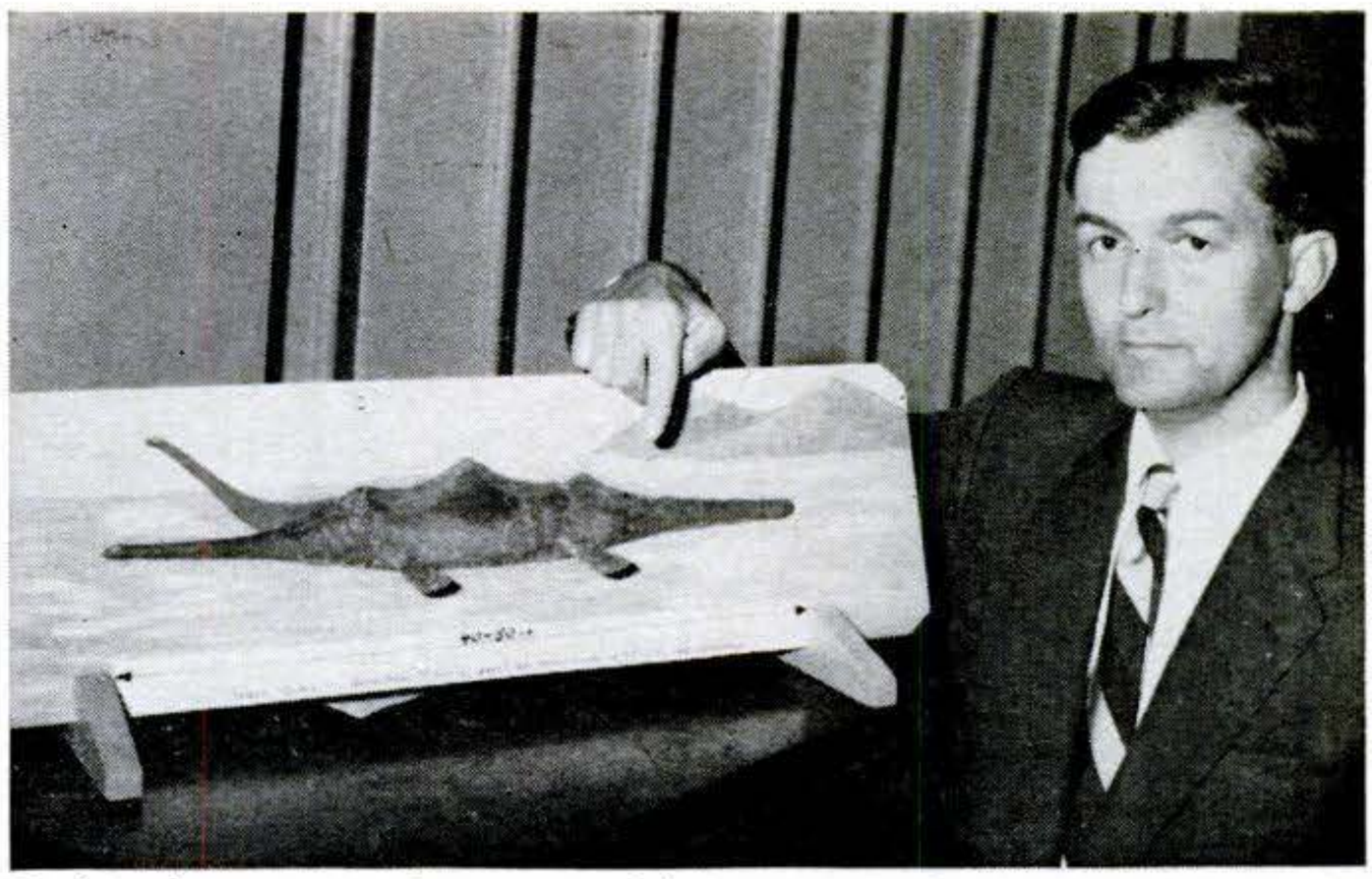
After detailed calculations of the mystery object's visible dimensions, wake, and speed, the report concludes that it rises three feet above the waterline; it is moving at 10 m.p.h.; and it is *not* a surface craft or submarine, "which leaves the conclusion that it is probably an animate object." The report continues:

"Even if the object is relatively flat-bellied, the normal body 'rounding' in nature would suggest that there is at least two feet under the water, from which it may be deduced that a cross section through the object would not be less than six feet wide and five feet high."

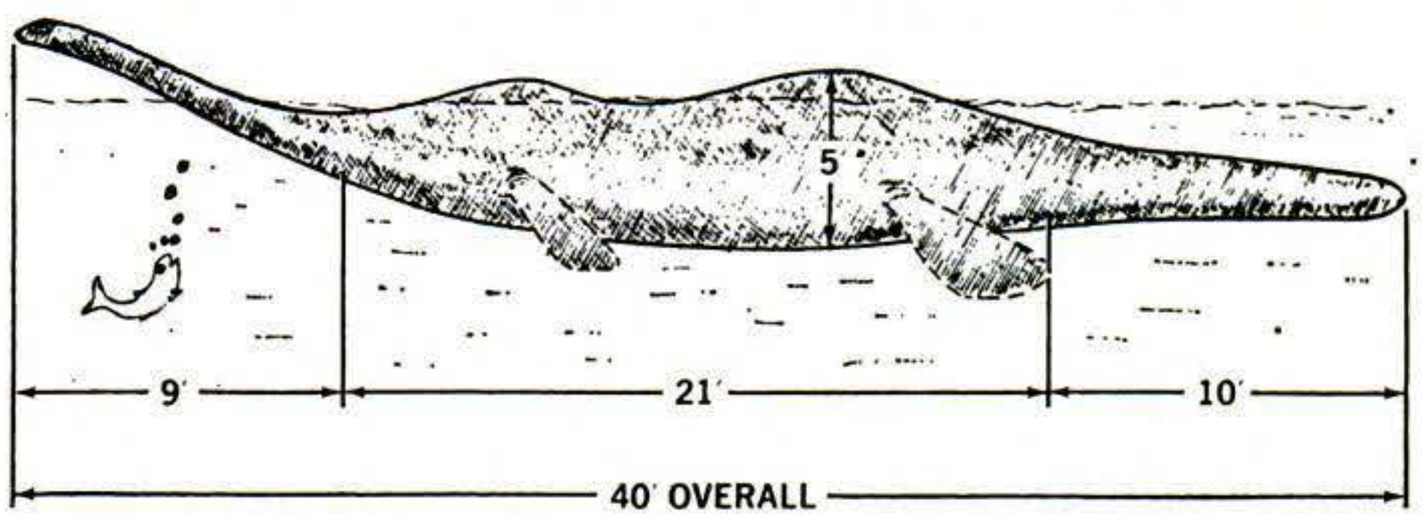
With this report, the pooh-poohed Loch Ness Monster suddenly became respectable.

What is it? A drawing and a model of the gigantic mystery creature, based on the few existing photos and on more than 100 eyewitness reports, present a strange-looking animal.

To some it resembles a plesiosaur—a fish-eating and egg-laying reptile from the age of dinosaurs. These giants, adapted for life in the open sea, grew to 30-foot length. They had a barrel-shaped body, four paddle-like limbs, a long slender neck, and a tiny head with a large mouth and pointed teeth. Since they supposedly became extinct 70 million years ago, living ones in Loch Ness would be a sensational find—



Model of monster, based on sightings and photos, is exhibited by Tim Dinsdale, its maker. Neck is shown both raised and lowered.



Drawing is composite of eyewitnesses' descriptions. These differ mainly in number of humps—suggesting body may change shape.

but one not without precedent, adherents of this idea note. They point to the coelacanth, a primitive fish believed extinct for as long, until the first of many living specimens was caught off Africa in 1938.

Or a giant sea slug? Other naturalists plump for some kind of a mammoth invertebrate. It could be, they say, an enormous and unknown variety of sea slug—a type of mollusk that was among the first creatures on earth. Like its little brother in the radish patch, which can elongate its body to enter worm burrows in search of food, such a creature could shape its bulk into the one, two, three, or more humps seen by different witnesses.

Some think it's a newt, the only member of the salamander family found in Britain; it grows to three-foot length in Japan. Still others opt for a marine bristle worm. Among the highest forms of worm life, these have appendages called false feet, and a well-developed head with jaws; the body could convolute to form the humps visible on the water. All agree Nessie is neither a whale nor a shark; no blow-off or dorsal fin

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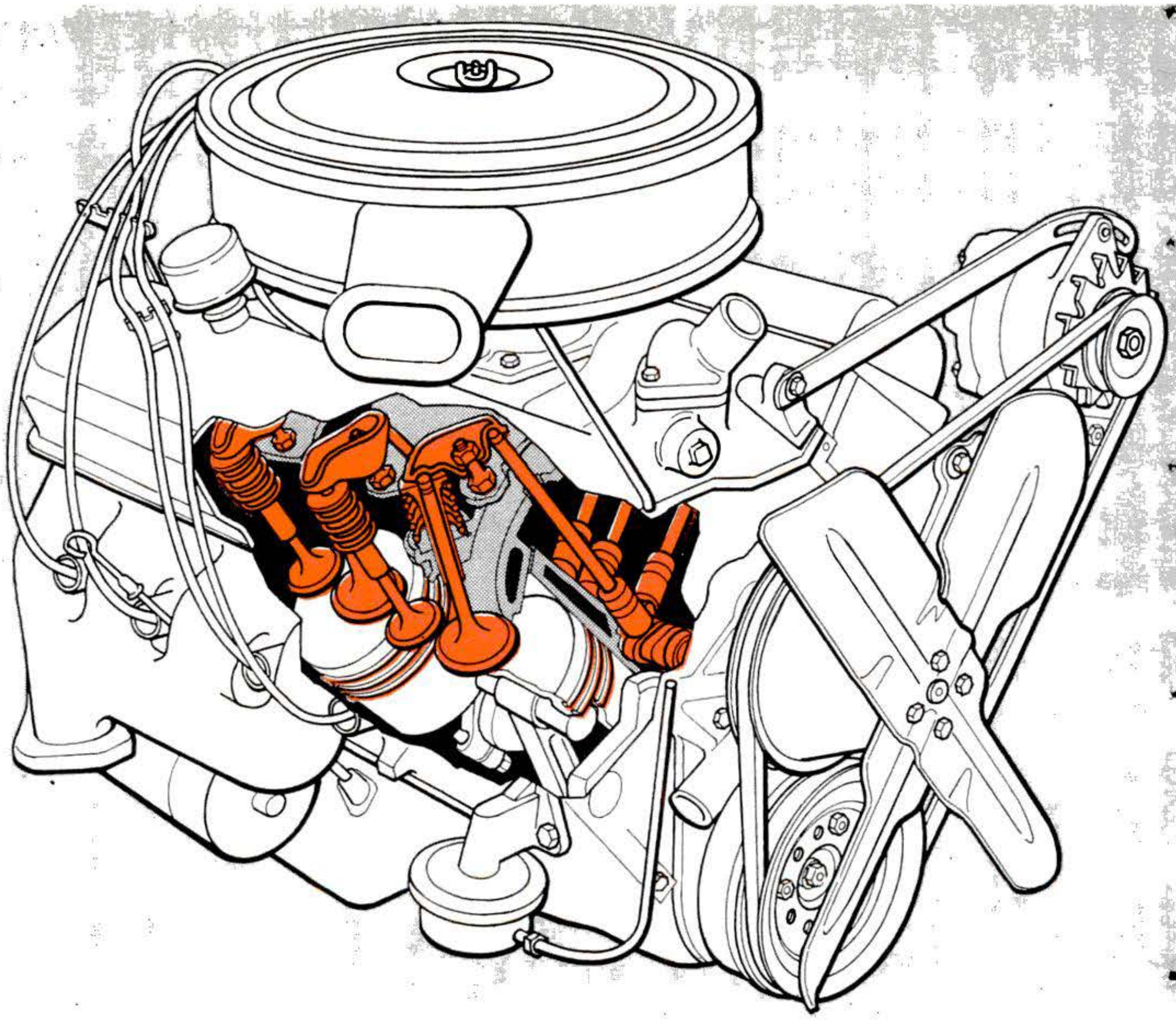

Parts that suffer if the engine is not broken-in right are the cylinder walls, pistons and rings, the camshaft, and the entire valve gear. Watch out for signs of overheating during the first 500 miles.

Is It Really Necessary to

Owner's manuals say less and less about running-in a new car. Here's the full story of what happens if you're careless

By JIM DUNNE / *PS Detroit Editor*

A new car is like a new pair of shoes. Give it time to wear the edges off its tight-fitting engine. Go easy on the brakes. The owner's manual tells you this. What it doesn't tell you is what happens if you ignore its directions about the breaking-in.

Two areas in an engine can be ruined by careless running-in: 1) Piston rings and cylinder walls. 2) Valve train and camshaft.

In a new engine, the rings do not seat perfectly against the cylinder walls. In some areas they press against the walls with higher-than-normal pressures, and in other areas they do not touch the walls at all. With proper run-in, the abnormal pressure areas are smoothed over. Cylinder walls and piston rings actually hone each other to a smooth fit.

Now, if the engine is run at high r.p.m.

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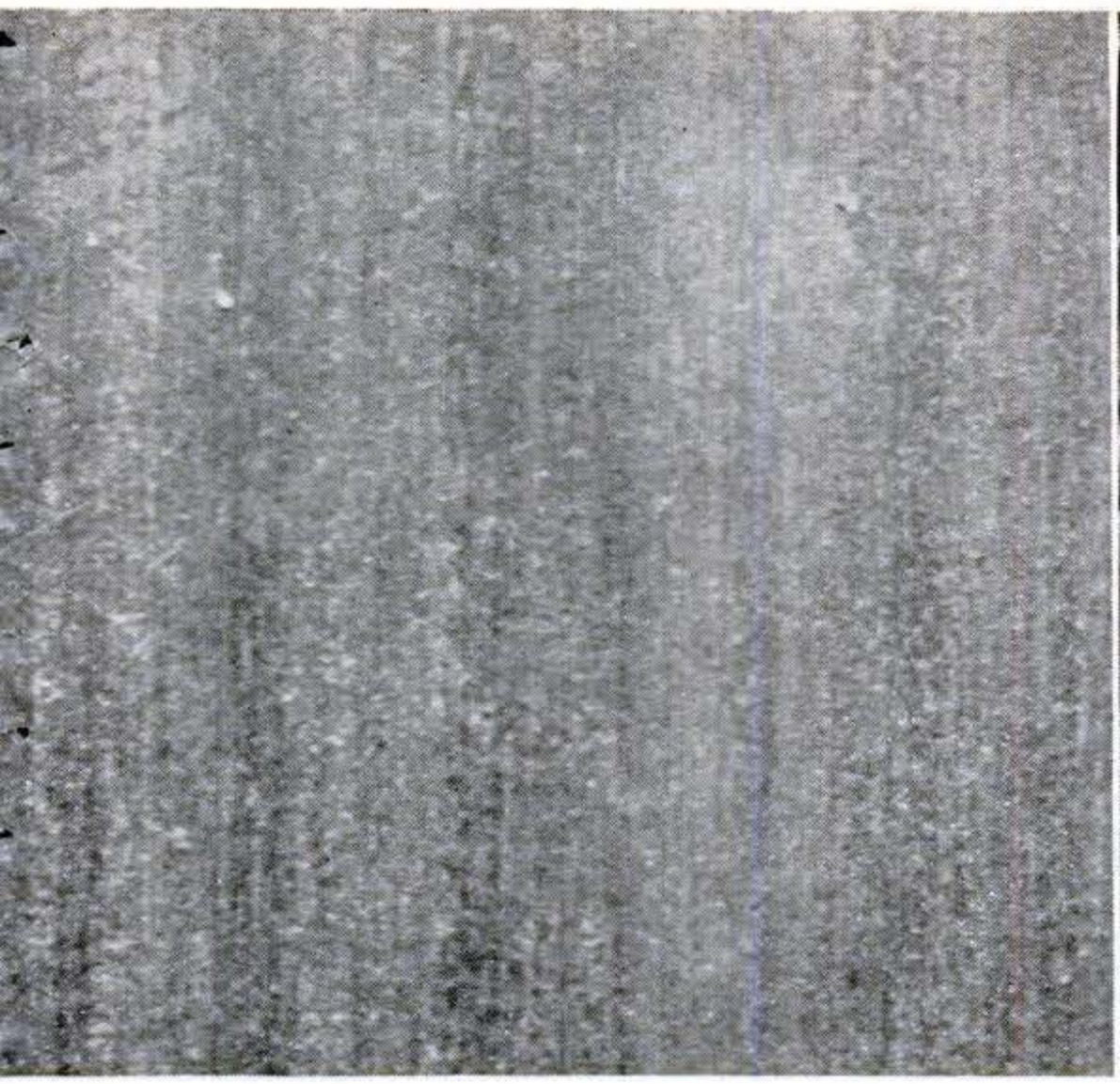
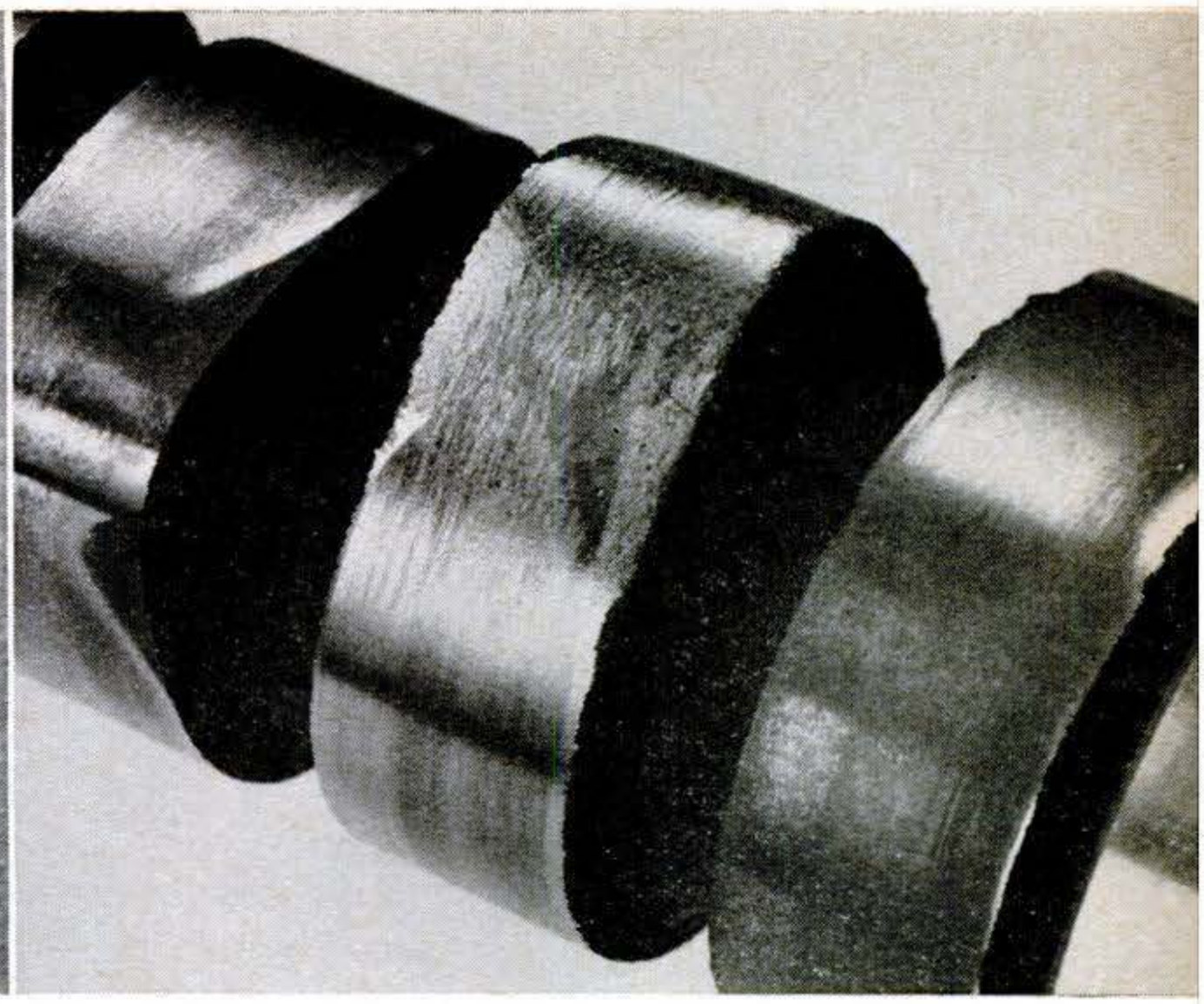
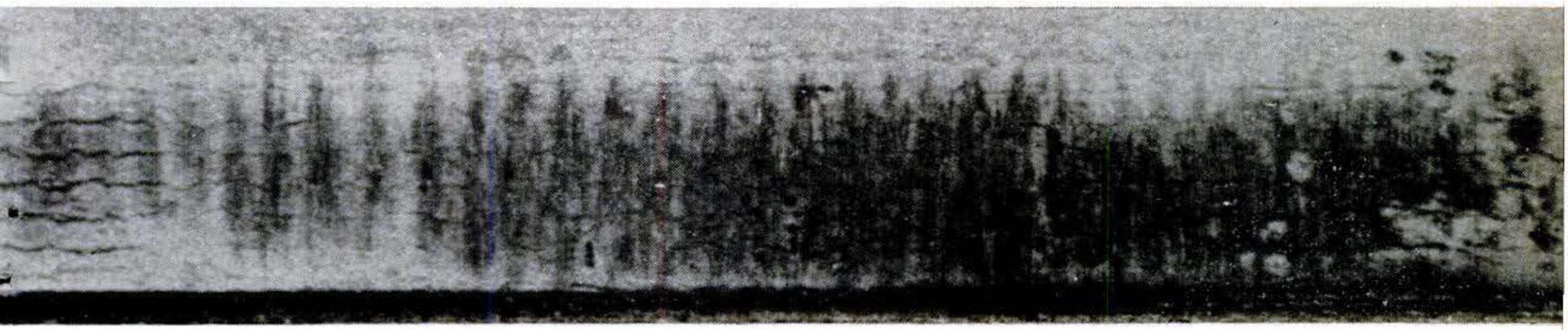


Metal particles from piston rings have become welded to this cylinder wall from a new engine that overheated. View is enlarged for greater clarity.



With high-lift cams and stiff valve springs, the loads on the valve gear are enormous. Over-revving a new engine caused scratching on this camshaft.



Abused piston ring in magnified view above shows vertical scuff marks from rubbing against a raw bore, and horizontal crack formations. This ring would disintegrate with continued abuse.

Break-In Your New Car?

when new, heat builds up on the face of the cylinder walls. Piston rings, at melting point, shed minute particles of metal, which weld to the walls (scuffing).

Then you've got big trouble.

Oil squeezes up past the faulty ring seal, and consumption soars. More heat builds up on the cylinder walls (it's a cumulative process; the more metal buildup, the more intense the heat) until finally rings break apart. That's when a new ring job and a honing operation on the cylinder are considered an easy way out.

Now that you know the problem, you know what to do to prevent it. But don't overcompensate. Keep in mind that you want those high spots to be rubbed off. They must be smoothed out if your engine is to reach its potential.

High speeds can be helpful. Chrysler Corporation owner's manuals recommend brief, full-throttle accelerations while cruising during the first 300 miles. This puts extreme pressure against the high spots, but it doesn't last long enough for high temperatures to build up. So you get the pressures to smooth out the ring and wall surfaces, without approaching scuffing heat.

Actually, slight overheating aids run-in.

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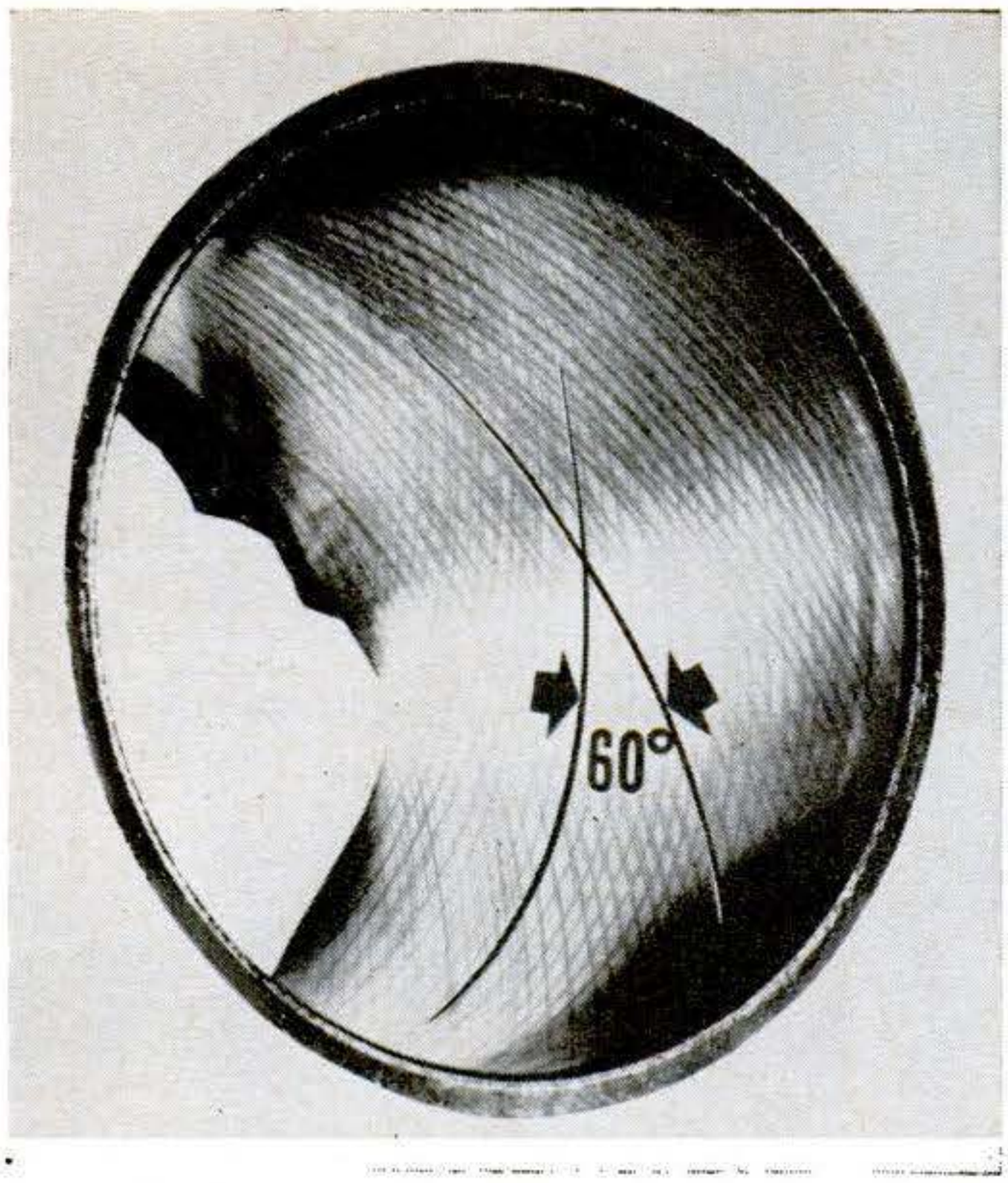
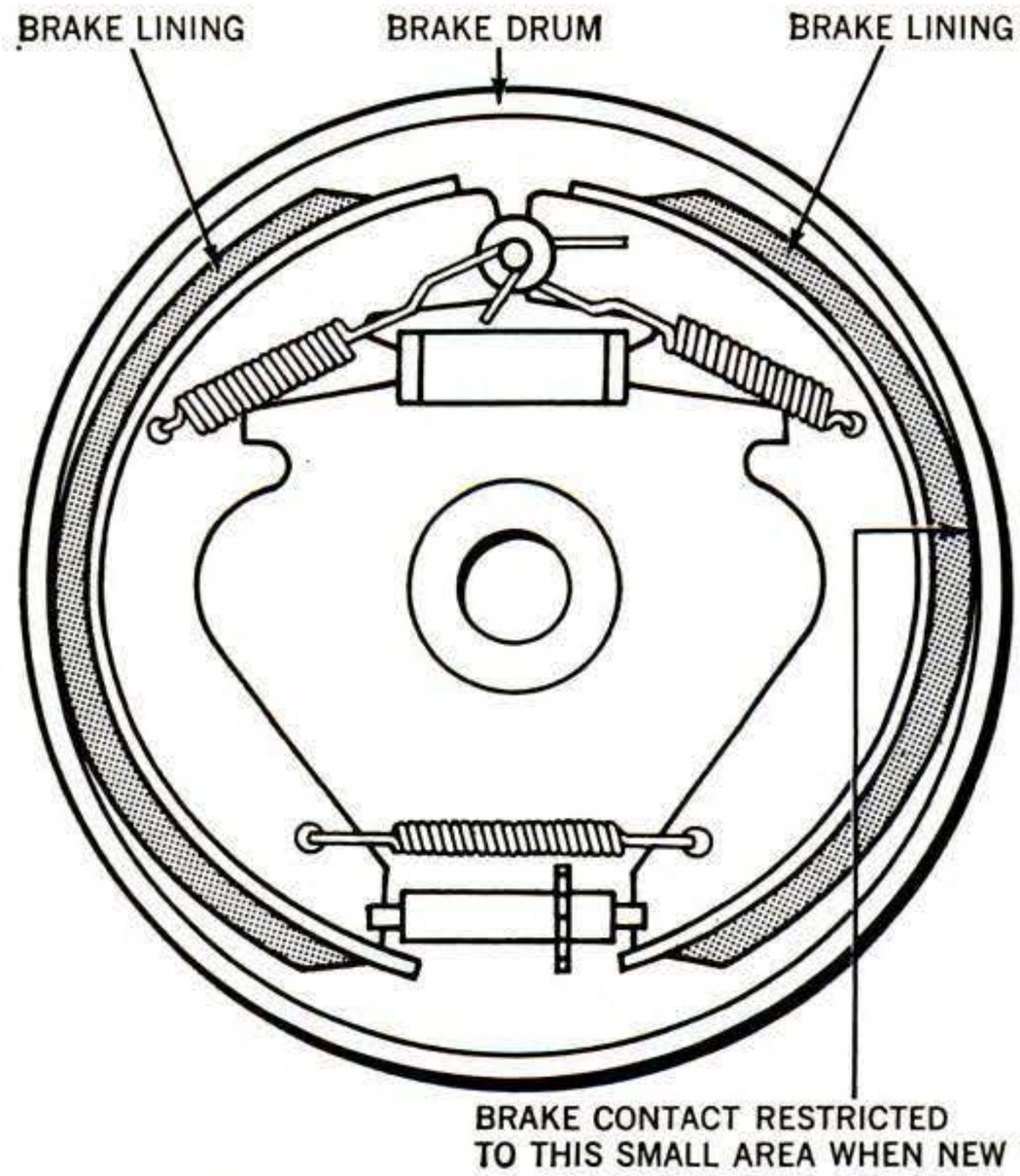


New cylinder bores have a cross-hatch pattern from honing. The engine will burn a small amount of oil until the run-in process has smoothed out the walls.



Brake linings in a new car only touch the drum in two small areas. New brakes must be carefully burnished before they give full friction surface.

Operating temperatures up to 200 degrees are okay. But don't go above this level. If your new car is running too hot, shut the engine down right away.

It is possible to damage the cylinder walls of your engine during run-in and not know it. Say the rings are slightly damaged. A car could run 40,000 miles before a ring job was needed. But this is far short of the normal life you can expect of a modern engine; it should go well over 100,000 miles before it needs new rings.

The most-affected valve-train parts are the high-pressure contact surfaces between the camshaft lobes and the valve lifters. Today's engines put tremendous loads on the camshaft and valves. For perfect fit, these parts must be worked together gradually. You, the driver, complete the metal machining needed to make your engine run smoother, last longer.

Oils and additives. Two old-time run-in procedures, obsolete now for nearly five years, involve so-called "break-in oils" and an oil additive that "plates your cylinder walls."

Break-in oil is nothing more than a light, neutral oil without the modern additives that protect your engine from wear. Oil expert Ray Potter of Ford says they used to be called "wear-in oils," a reference to their ability to wear the rough edges off a new engine quicker than motor oils.

Additives that plate cylinder walls and other moving parts of auto engines are mostly zinc dithiophosphate. This compound deposits a coating of sulfur phosphorus on engine parts to reduce wear, and does a remarkably effective job. It's so good, in fact, that all engine oils now on the market contain about one percent zinc dithiophosphate by volume. So you can disregard claims about the value of using plating additives to protect your engine. They're already in your crankcase.

Detroit engineers say that transmissions, rear ends, propeller shafts, clutches, and under-hood accessories such as air conditioning and power steering require no special break-in attention.

What about brakes? Your brakes need attention for the first 200 miles or so. Go easy when they're new, and you might avoid those uncertain stops, pulling to one side, or that lumpy feeling that suggests a drum is out of round.

Here are two important things to keep in mind: A final curing of the brake lining takes place after the brake is installed on the car. Curing brake linings is like baking a cake. It should be done slowly, as if in a low oven, so heat does not build up on one part of the lining too quickly. Un-

[Continued on page 208]

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Inspector photographs an abandoned 1953 Morris Minor.

Notice on windshield of the abandoned car warns it will be junked if not claimed.

London police go to work on abandoned cars

A tough new law places a seven-day limit on how long old heaps can remain on streets before they are hauled away for junking in the London Borough of Camden. The countdown starts from the moment an inspector finds a ditched car on the street. First step consists of taking photo of car and sending it to Scotland Yard in an attempt to trace last registered owner. At the same time, the inspector places a notice on car's windshield that sets deadline for car to be towed to scrap yard.

Worshippers wait to enter double-deck bus which has been converted into a mobile chapel.

Rev. B. G. Apps conducts services in front of the altar on the lower level of the rolling church.

Double-deck bus becomes rolling chapel

The two-level bus (above) was pressed into service as a rolling chapel in Andover, England, recently to create more space for worship in the town, which has a shortage of churches. The lower-deck sanctuary has an altar and seats for 16 worshippers. The upper deck has two rooms, which are used as Sunday School classrooms. These can accommodate up to 50 children. Rev. Bryan Apps, who thought up the idea of converting the bus into a church, drives it to various locations for services. Ten volunteers also take turns in driving the vehicle.

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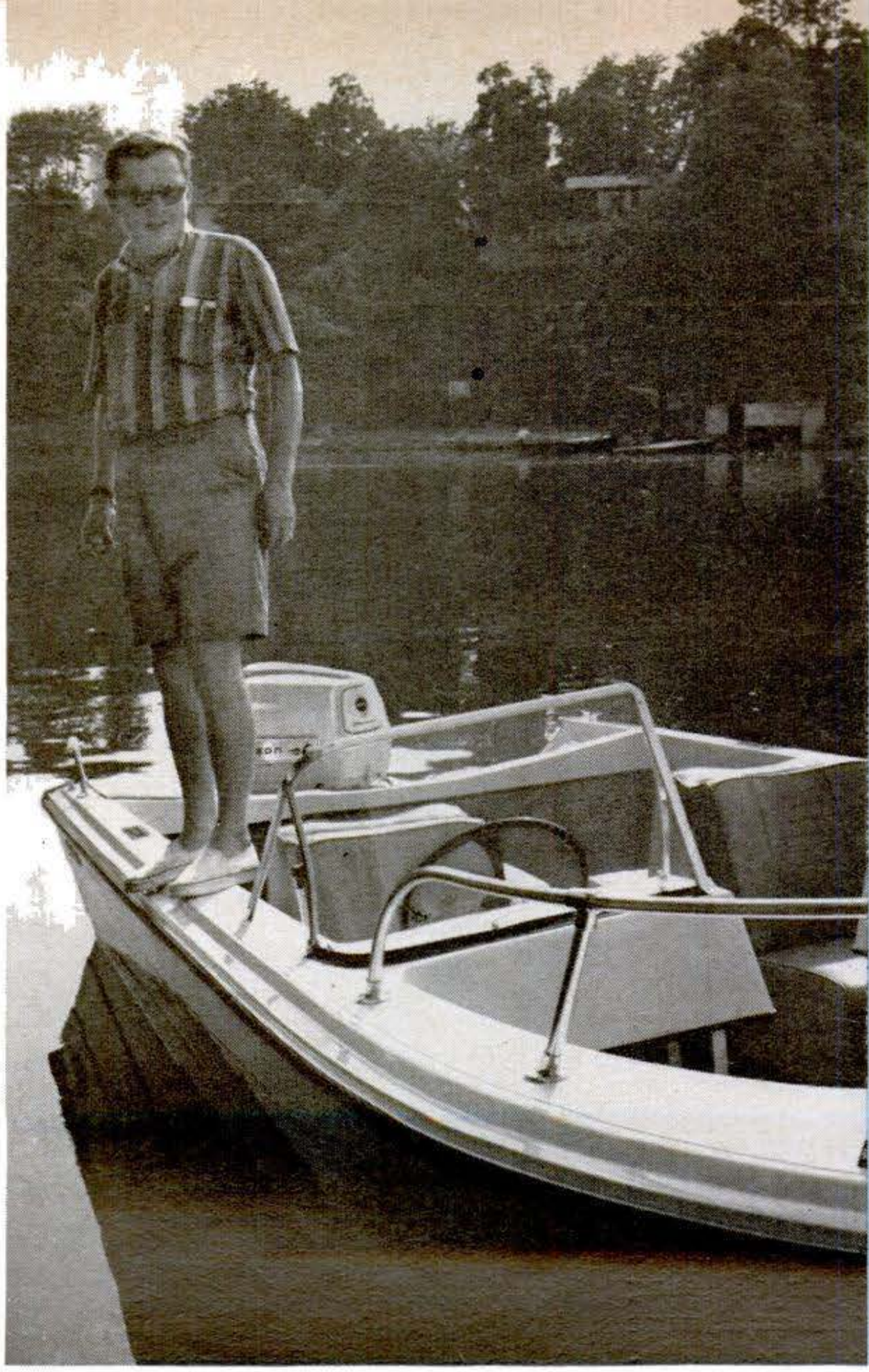

DAYTONA-TR SPECIFICATIONS

Centerline length	17′ 2″
Beam	7′ 5″
Weight (approximate)	1,000 lb.
Load capacity	8 people or 2,000 lb.
Power rating	110 hp.
Hull design	trihedral lapstrake
Type	fiberglass sportabout

Standard Equipment:

Twin wraparound Plexiglas windshields, back-to-back convertible sleeper seats, upholstered bow seat, side steering station, mechanical steering, bow and stern lights, bow rail, live-bait well, underseat storage compartment, vinyl floor covering, vinyl-covered side panels, side storage racks, drain-fitted motor well, aluminum transom cap, bow eye, bow casting, stern-lifting eyes, siphon drain, bow cleat, chocks and stern cleats, step pads, gunwale moulding with vinyl insert, non-skid deck finish, and air-chamber flotation in hull.

Styling:

Hull: autumn gold. Deck: Bermuda cream.

Price:

$1,525, without motor, f.o.b. Goshen, Ind.

Manufacturer:

Starcraft, Goshen, Ind. 46526.

Bow high, the Daytona under way (right) shows her unique configuration. With three keels under her, stability is great. Stand on the gunwale (left) or even jump up and down—there's no tipping.

Cool New Three-Keeler

Starcraft's Daytona, new for '67, is a surefooted family friend. Our prediction—you'll like it

By JIM ROE / *PS Boating Editor*
PHOTOS BY OZZIE SWEET

The Daytona, precocious new member of the Starcraft family, is 17′ 2″ of fiberglass trihedral hull. We had a chance to pretest this 54th member of the Starcraft family while one of the first hulls was sitting for its baptismal photographs. The place: western Indiana, where the Tippecanoe River has been dammed up to form Lakes Freeman and Schafer.

At first glance you know that the Daytona is going to be an interesting and happy boat. It has a pleasing configuration—still "boat-shaped," even with its trihedral hull design. It's a sensibly outfitted no-nonsense craft. Yet even while it's tied to the dock it tugs at you to do some water skiing, take a few high-speed runs across the lake, or organize a picnic on the far shore.

This is a roomy boat, one that will accommodate a large family or allow you to take a good number of your friends along. Starting at the bow: There is a wraparound cushioned seat that offers room for four or five adults or a whole troop of small fry. Going back amidships through the walk-through windshield, you come upon convertible seats to port and starboard. These provide two forward- and two rear-facing seats. But with the backs laid flat, they become two full-length sunbathing or snoozing lounges. And if you run into still

Continued

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Is Stable and Sassy

Horsepower rating of Daytona is 110. Test boat carried 100-horse Johnson Meteor. Combination gave top pickup, high speed. As photo shows, boat cruises easily with clean entry and little wake.

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one more friend on the dock who wants to go along, there is a padded seat on the built-in bait well at the stern.

Ski-length storage shelves are built in along each side beneath the gunwales, and there are two hinged-top storage compartments beneath the after ends of the bow seat. Adjoining these compartments is a large built-in flotation chamber in the bow itself. Space beneath the motor well is ample for a battery and two or three six-gallon fuel tanks.

She's a roomy boat, a 17′ passport to fun. Walk-through between twin windshields leads you to a wraparound bow seat, with flotation chambers and storage compartments beneath. There are fold-down seats at rear for resting or sunning. Fishing in mind? That's a bait well near the stern.

Horsepower rating of the Daytona is 110. Our test boat was equipped with a 100-horse Johnson Meteor.

Driver visibility in the Daytona is good. From the driver's seat, you can keep good track of the water ahead, and approach a dock with a feeling of being in command of the situation—although, personally, I never look through a windshield when it's convenient to look over the top. The driver's seat of the Daytona proved to be placed just right for this style of driving, too.

Under way, this brand-new boat performed like an old pro in the crowded lake. We were constantly crossing and crisscrossing the wakes of other boats—one of the conditions that makes a trihedral hull strut its stuff. The Daytona proved stable and surefooted all the time.

I was eager to try the trihedral trick of perching atop the wake of the boat ahead and riding along on top of the crest. A boat with a conventional hull slides off the crest, giving you the old stomach-dropping sensation on the way down. But the Daytona's three keels each grabbed a hunk of water and we rode along on top, pretty as you please. And in high-speed turns the three keels dug in their toes to bring us around without a slip or trip.

The boat's fiberglass hull is molded with nice reinforcement at points of stress. The design was proved out with test hulls altered and reworked until running experience proved them just right.

I found only two minor bugs. One was simply a matter of torque adjustment on the motor. The motor had a strong tendency to pull us to starboard, giving the boat a very tender and uncomfortable feel on a hard turn to port. The other problem was underfoot. When wet, the rubber floor matting was slippery. Even with boat shoes, it provided poor purchase; I had to brace my feet against the seats and other hardware while in tight turns.

All in all, the Daytona is a clean boat, with a minimum of square corners or protruding sharp objects to catch an unwary shinbone. She shows evidence of careful thought from a designer who is a real boatman—and knows what is necessary, what is handy, and what is simply gingerbread. PS

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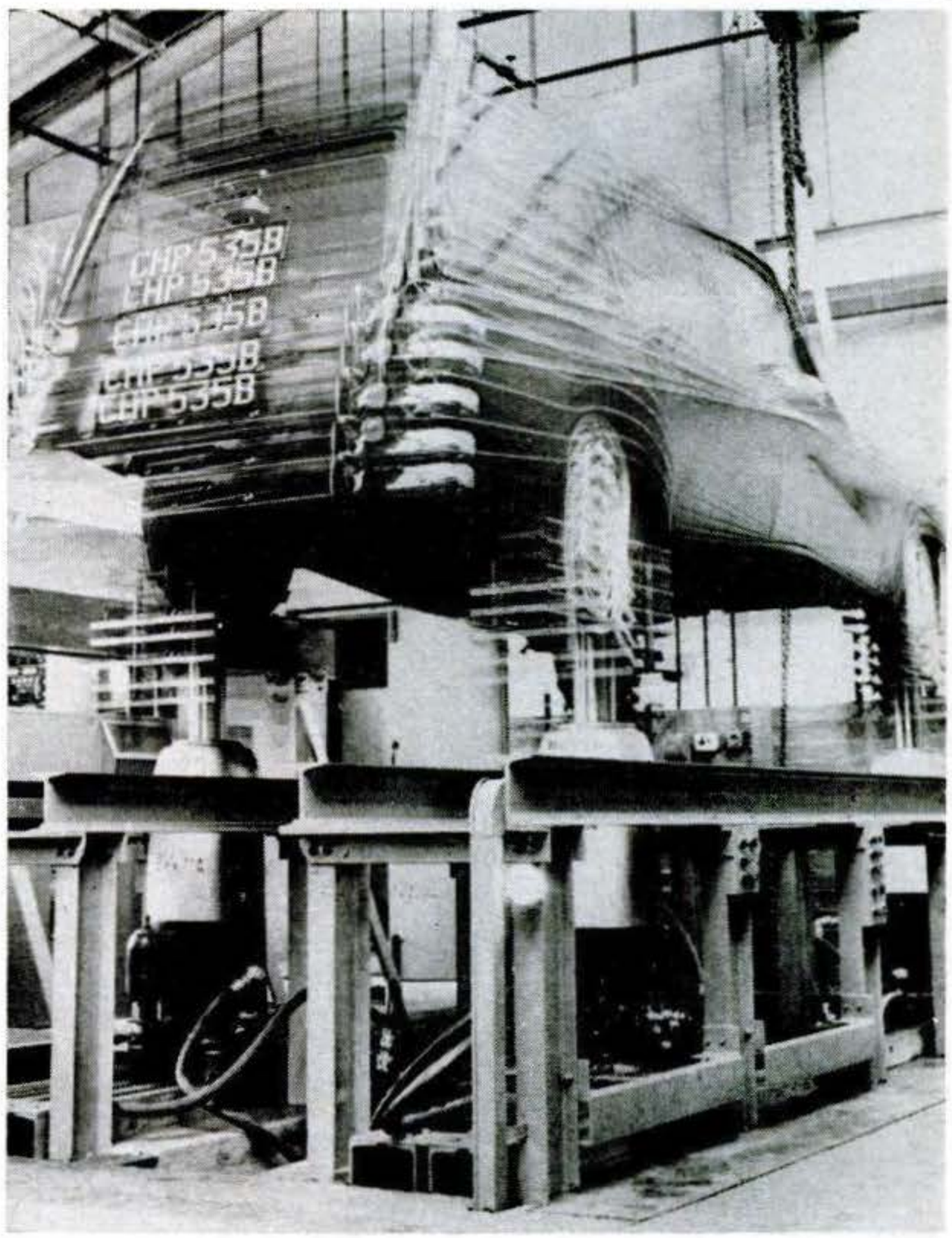
Transducers on radial arms swing over model road to feed signals to vibrator.

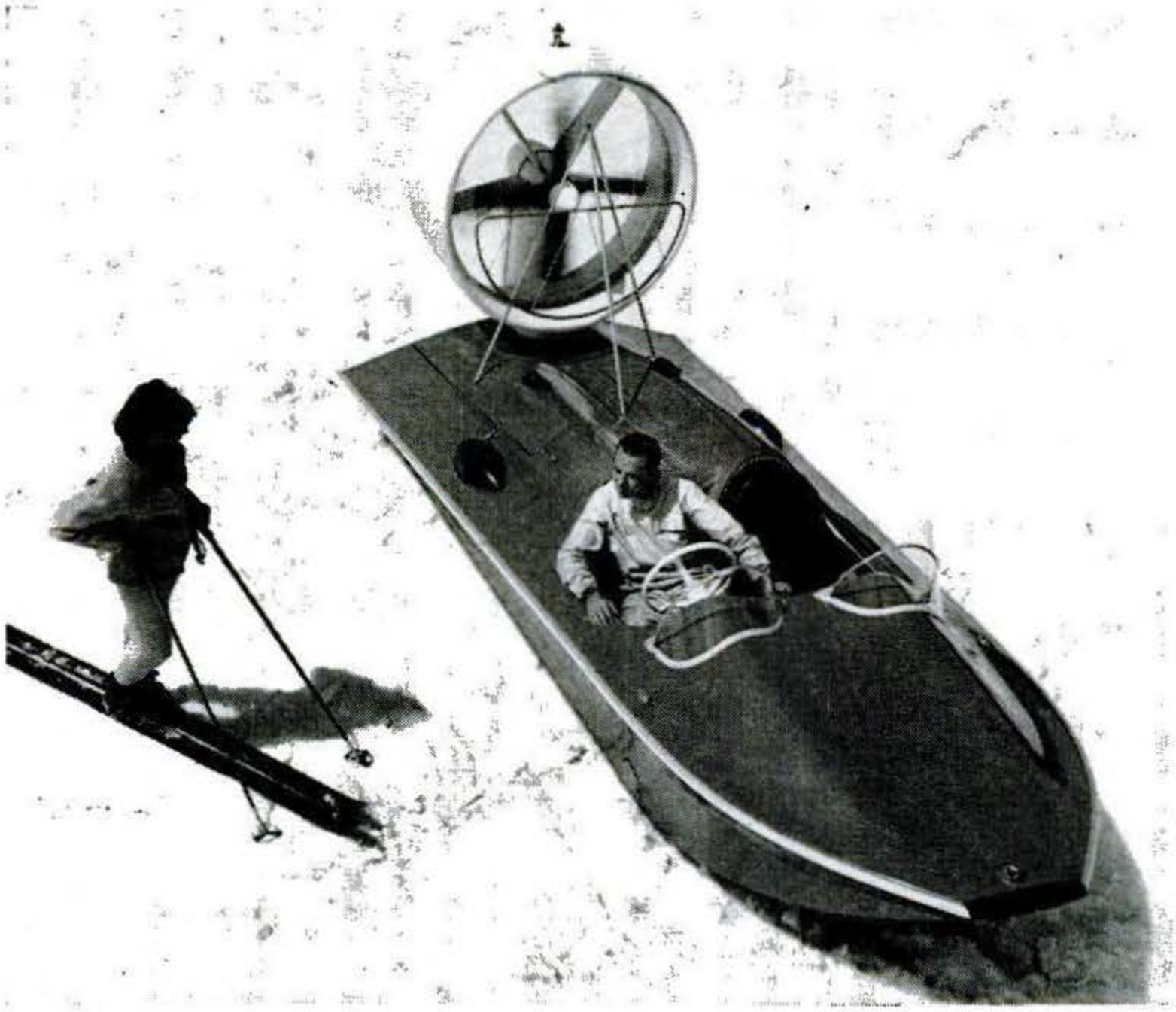
Table top road-tests cars

Table-top roads provide realistic lab tests at Rootes' British factory. The rig, made up of concentric rings of two-inch-wide tracks for 1/32-scale road surfaces, is on a six-foot table that rotates at eight r.p.m. for a simulated 60-m.p.h. ride.

Four transducers on radial arms act as car wheels. Their probes detect bumps and feed amplified signals to hydraulic vibrators supporting the wheels of a real car. The table-top circuit is repeated every 7½ seconds.



Car on vibrating rack bumps up and down during realistic lab test of suspension and ride comfort on simulated highway.



Prop craft rides snow, ice, mud

This propeller-driven fiberglass boat speeds up to 40 m.p.h. on water and 60 m.p.h. over snow and ice. It travels with ease in mud, too.

Power is transmitted by a toothed belt from a standard Corvair engine. The duct around the prop greatly increases thrust. The Nordalk II is built by Aquanautics, Inc., of Mountain View, Calif.

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PS ELECTRONICS

The PS Buyer's Guide to PERSONAL TAPE RECORDERS

Here's what we learned when we tested the 17 most popular portable tape machines

By C. P. GILMORE
PHOTOS BY ROBERT D. BORST

We judged 17 test recorders primarily

They're everywhere you look—in drugstores, radio shops, department stores. They range in price from $9.95 to more than $1,000, and there must be hundreds of makes and models available of these ultrasmall, carry-'em-around-with-you, battery-powered tape recorders.

Some are designed to serve as "audio cameras"—you take them along when you travel and capture the sounds of faraway places. Others can be used as portable dictating machines—you can record business notes and correspondence as you drive to work, or your wife can make "audio shopping notes" for herself as she checks the inventory in the pantry. A few machines—the best of the breed—perform well enough to come along with you to concerts and make live recordings you can replay on your hi-fi tape player. And all of them are perfect family fun machines. You can use them to tape Junior's first words, to terrorize guests at your next party, and to send "voice letters" to anyone else who owns a tape recorder.

As a reasonable cross section of the many recorders available today, we picked 17 machines to check out in detail. Our standards for picking them were simple: They had to be made by leading companies, either domestic or foreign; they had to be widely available in this country; and the machines selected had to cover a moderately wide price range.

Our evaluation of the recorders follows in a moment, but first here are some things to keep in mind when shopping:

- Foot pedal. Get one if you plan to transcribe conversation. But first check two things. For effective use with a foot pedal,

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n their ability to record voice, but a few turned out to be good music makers, too.

a machine should coast as little as possible when you stop it. Some coast a syllable or more, so on playback you have to back up and start again almost every time to keep from missing a word; others stop almost immediately.

- Telephone pickups. Available with most machines, valuable if you plan to record telephone conversations—a great improvement over note-taking. They stick onto your phone with a suction cup. You may want to consider a machine with automatic volume control (AVC) for this purpose. Your voice is much louder at your telephone than is the voice from the other end. When you play the conversation back, your voice keeps blasting out. AVC solves the problem.
- AVC. Useful not only for telephoning, it's fine for recording general conversations. It's not an unmixed blessing, though. For music it's bad. The ups and downs in volume help make music interesting. AVC smooths them out. Some recorders have an AVC defeat switch—you can switch the automatic part on or off. If you plan to record both voice and music, and at the same time want to buy a machine with AVC, make sure it has a defeat switch.
- Voice-actuated mike. Some recorders have this as an extra feature. When you talk, the recorder goes; when you stop, it stops. Fun to play with, but not very useful. And they cost $20 or more.
- Rechargeable batteries. Many people want them. Some don't. They may save money in the long run, but it will take a lot of long running, since they cost a good bit more to begin with. And besides, replace-

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FACTS AND FIGURES ON SEVENTEEN

MAKE AND MODEL	APPROXIMATE PRICE	SIZE—LENGTH x WIDTH x HEIGHT (inches)	APPROXIMATE WEIGHT (lb.)	TAPE SPEEDS (inches per second)	MAXIMUM REEL DIAMETER (in.)	FREQUENCY RESPONSE AT HIGHEST SPEED (HERTZ)
CHANNEL MASTER 6456	$50	6⅜-6⅜-2⅛	2	1⅞	2½	300- 3,000
WESTINGHOUSE H29R1	$70	6½-3¾-1½	3	[B]	Car.	300- 2,000
NORELCO 150	$90	8-4½-2¼	3	1⅞	Car.	120- 6,000
CONCORD F-100	$100	8-4¾-2⅜	3	1⅞	Car.	60-10,000
PANASONIC RQ 105S	$50	10¼-7¾-2⅝	4	3¾-1⅞	3¼	100- 7,000
CHANNELMASTER 6426	$50	9¾-7⅞-3⅛	4	3¾-1⅞	3¼	200- 5,000
RCA YGS-11	$40	10-9-3	5	3¾-1⅞	3¼	400- 3,000
WESTINGHOUSE H32R1	$60	10½-9½-3	7	3¾-1⅞	3¼	500- 5,000
SONY 900A	$70	8¾-8¾-3¾	5½	3¾-1⅞	3¼	90- 9,500
NORELCO 101	$80	11-8-3¾	8	1⅞	3¼	80- 8,000
VM CHARGER	$130	10⅝-6-2¾	5	3¾-1⅞	3¼	200- 6,000
CONCORD 300	$130	10¼-9-3¾	6½	3¾-1⅞	4	70- 4,000
PANASONIC RQ 152S	$100	11¾-10-3½	6¾	3¾-1⅞	5	100- 7,000
CHANNEL MASTER 6464	$110	11¼-10-3½	8½	3¾-1⅞	5	100- 7,000
TELEFUNKEN 300	$150	11½-10½-3	8	3¾	5	40-14,000
SONY 800	$200	12¼-10¼-4¼	12	7½-3¾-1⅞	5	50-18,000
UHER 4000 L	$440	10½-8½-3¾	7	7½-3¾-1⅞-15/16	5	40-20,000

NOTES: [A] With optional adapter. [B] Speed is variable, since this is a reel-driven machine. N.A.—not available. OPT.—optional.

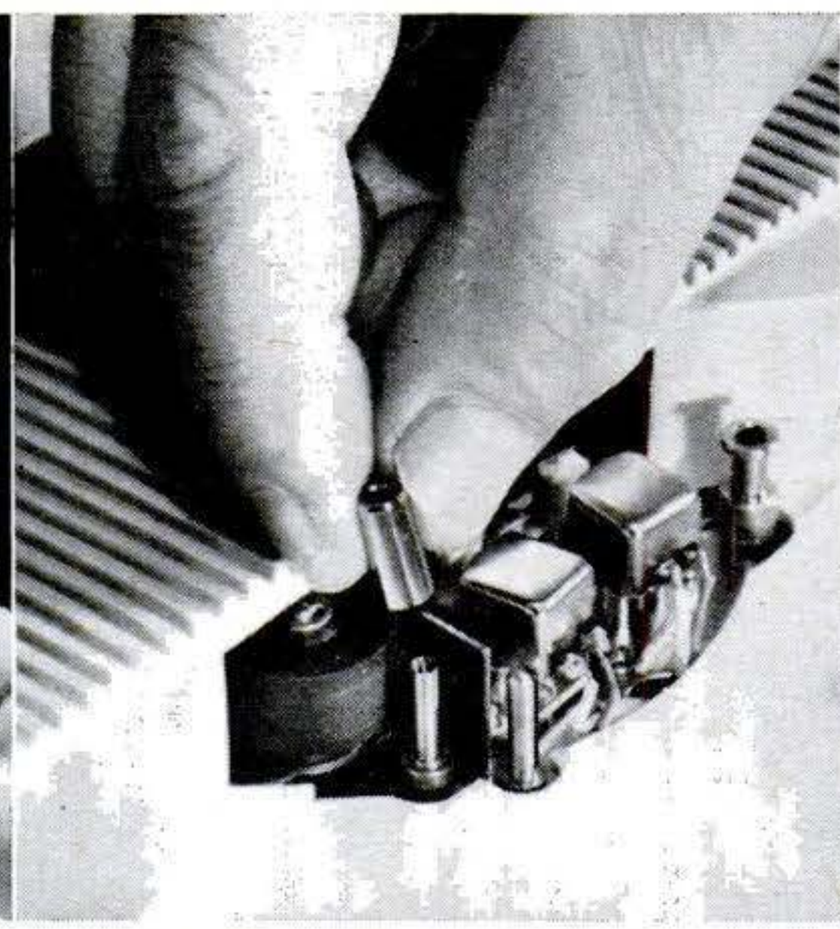
able batteries are convenient. Flashlight cells—the kind recorders use—are cheap, available everywhere, and easy to install. When the machine runs down, stick in a new set. If you run down with a rechargeable battery, you're out of business for all the recharging hours.

Now, here's how those 17 tape recorders stacked up:

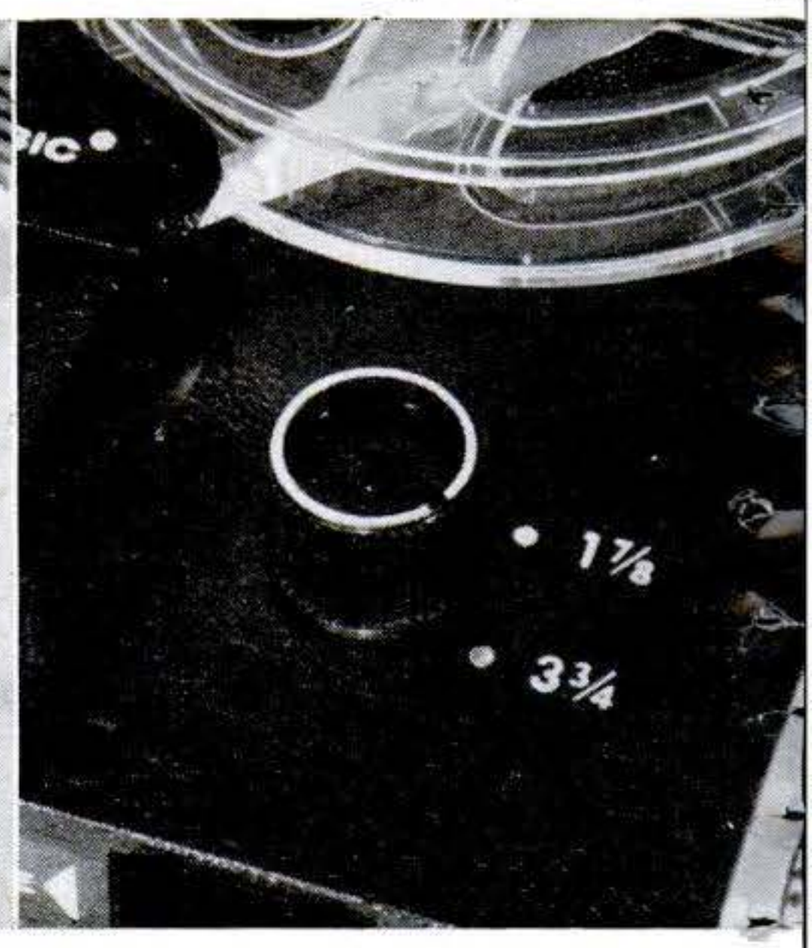
The mighty miniatures. Two clear favorites: the Norelco 150 and the Concord 100. They sound pretty much alike and it's not surprising. While their specifications as given by the manufacturers don't jibe ex-

Tape recorders vary in many detail features: in mikes, tape-speed

Telefunken's unique TD-300 cardioid (directional) mike is an option for the model 300 recorder. Its built-in volume-unit (VU) meter lets you monitor the recording level without looking at the recorder.



This crude technique is used by many low-cost multispeed recorders to change tape speed: You slip a collar over the capstan shaft that makes it thicker, and the capstan pulls tape at a higher speed.



All the monster multispeed rigs as well as a few of the smaller units have speed-change controls similar to the type used on conventional hi-fi recorders. Advantage: faster, simpler speed changes.

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PERSONAL PORTABLE TAPE RECORDERS

S/N RATIO (db.)	WOW AND FLUTTER AT HIGHEST SPEED (percent)	OUTPUT POWER (milliwatts)	AUXILIARY (RADIO) INPUT	TYPE OF DRY-CELL POWER SOURCE	RECHARGEABLE BATTERY?	RUNS ON A.C.?	CASE INCLUDED?	EARPHONE INCLUDED?	DIGITAL COUNTER?	AUTO. VOLUME CONTROL?	A.V.C. DEFEAT SWITCH?
38	.50	350	Yes	6 AA's	No	Yes[A]	No	No	No	Yes	No
40	1.0	100	No	4 AA's	Opt.	Yes[A]	Yes	Yes	No	No	. . .
45	.35	250	Yes	5 C's	No	Yes[A]	Yes	No	No	No	. . .
40	.25	250	No	5 C's	No	Yes	No	No	No	No	. . .
40	N.A.	1,000	No	4 C's	No	Yes[A]	No	No	No	No	. . .
42	.25	700	Yes	6 D's	No	Yes	No	No	No	Yes	No
26	.85	200	Yes	4 C's	No	Yes[A]	No	Yes	No	No	. . .
35	.60	150	Yes	4 D's	No	Yes[A]	No	Yes	No	No	. . .
42	.25	1,000	No	4 D's	Opt.	Yes	Yes	Yes	No	Yes	No
45	.35	500	Yes	6 D's	No	Yes[A]	No	No	No	No	. . .
40	N.A.	500	Yes	. . . .	Yes	Yes	Yes	No	No	No	. . .
38	.15	900	Yes	6 C's	No	Yes	No	Yes	No	Yes	Yes
40	N.A.	1,000	Yes	6 D's	No	Yes	No	Yes	Yes	No	. . .
40	.25	850	Yes	6 D's	No	Yes	Yes	No	Yes	Yes	Yes
50	.2	1,000	Yes	5 D's	Opt.	Yes	No	No	No	No	. . .
42	.15	1,000	Yes	8 D's	No	Yes	No	Yes	Yes	Yes	Yes
55	.15	1,000	Yes	5 D's	Yes	Yes	Yes	No	Yes	No	. . .

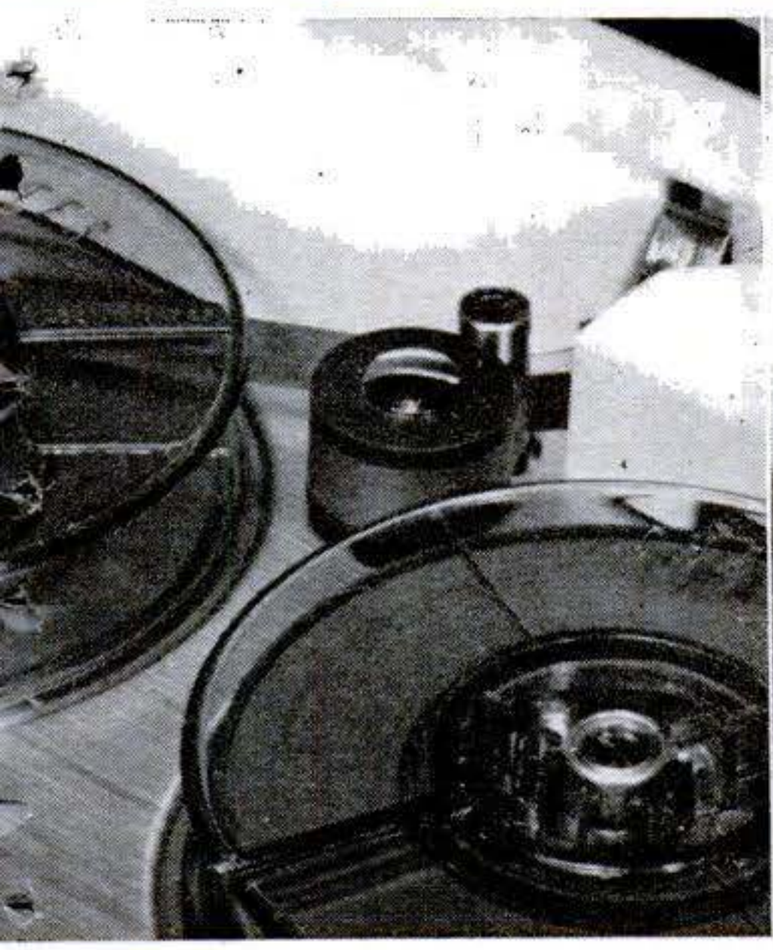
actly, we can't hear any significant difference. It's obvious that they're virtually identical machines, packed in slightly different cases.

The Norelco (and its brother) is one true miniature that plays music well. It even sounds pretty good playing through its own small speaker. When played through a large amplifier and speaker, it's unbelievable. It costs $90 to $100, depending on label and where you get it, and it's well worth it. Incidentally, you can also buy prerecorded tape cartridges for them.

In easy second place is the Channel

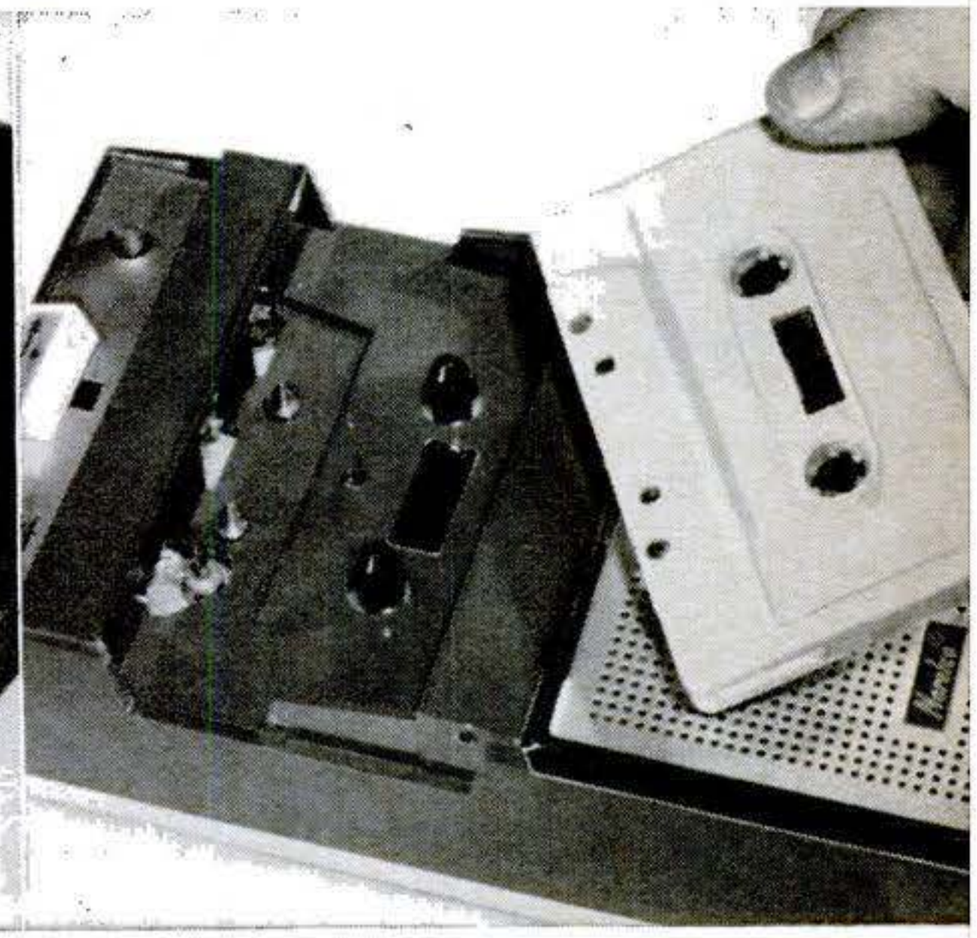
Continued

change, tape-drive system. But there's one to suit any need



Capstan tape-drive system is used on all machines tested by PS except the Westinghouse H29R1. Tape is propelled as it is squeezed between motor-driven metal capstan and a rubber pinch roller.

Westinghouse H29R1 uses a simple reel-drive system to move tape past the heads: A motor-driven shaft presses against the take-up reel to turn it. But speed isn't constant as with capstan drive.



Cartridge developed by Phillips of Netherland is used in Norelco 150 and Concord F-100. Many other recorder manufacturers have announced plans to build similar machines that will use this cartridge.

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The machines we tested fell into three natural categories

Master 6454, another astonishingly good machine, particularly considering price—under $50. It doesn't have either the frequency response or speed regulation of the Norelco, but music—if it's not too slow—sounds okay. Voice reproduction is excellent, despite the extremely small size.

Another machine—the Westinghouse 29R1—doesn't match either of the others in quality of reproduction or playback. But it's so small that you can actually slip it in your inside coat pocket.

The moderate middles. Here's where you've got to decide what you want. For music, there's only one recorder in the running in this category: the Norelco 101. It has a huge (for portable tape recorders) four-inch speaker, and is one of the best-sounding portables in any class for music. Voice reproduction is good, too, but you pay for that big speaker in size and weight; it's one of the biggest and heaviest (eight pounds) of the middle class. And the reels are stuck up on top to clear the side for the speaker.

In the voice-only category, a fine choice is the Sony 900A. Overall quality and intelligibility are fine. Its automatic volume control works well, but (like the Channel Master 6426) can't be defeated. The new Sony, incidentally, has a flashing light that shows when you're recording; great for your confidence.

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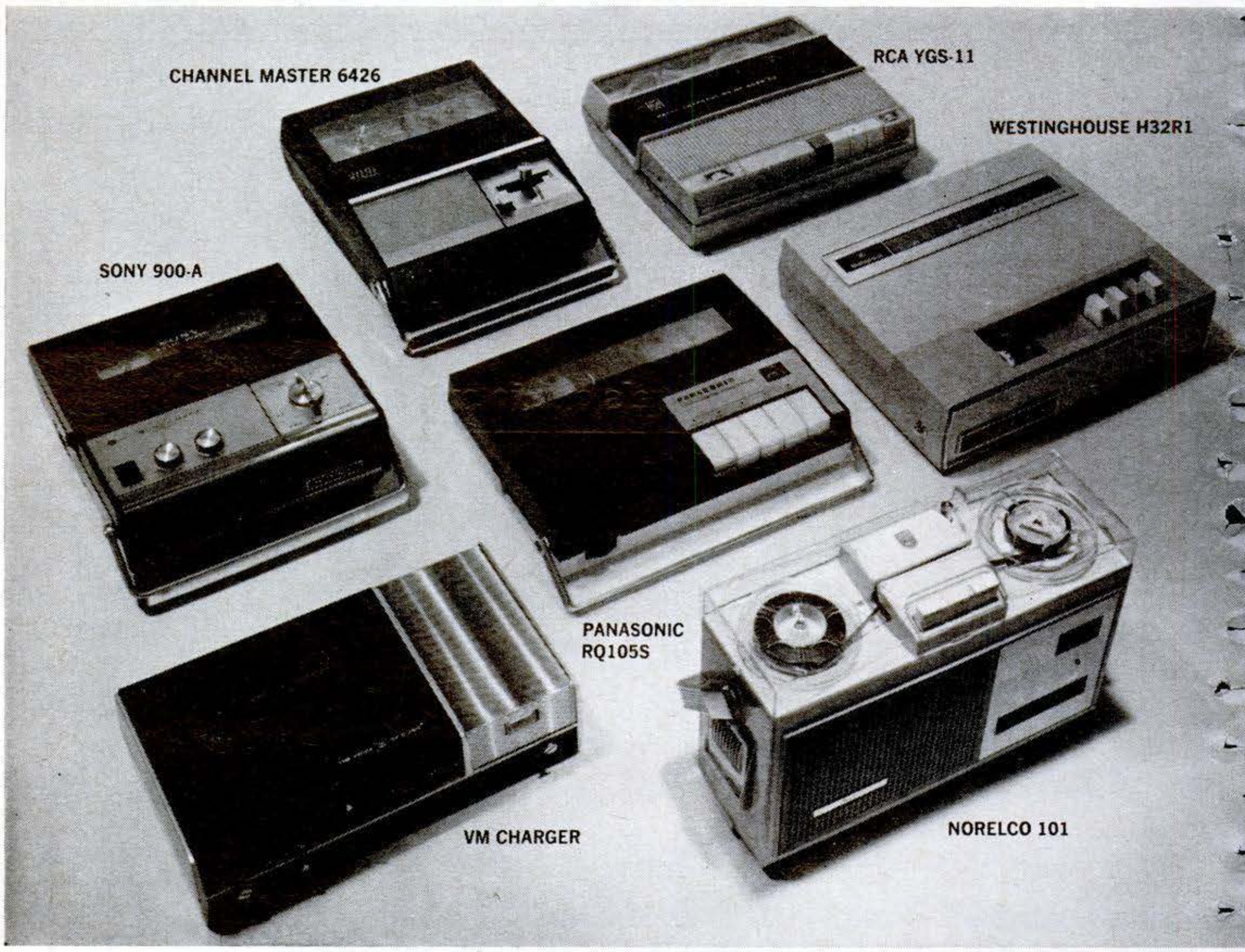

THE MODERATE MIDDLES

Biggest group of portables weigh four or five pounds, and are about the size of a volume of the *Encyclopaedia Britannica*. All take 3¼-inch tape reels, and at their slowest speed will record for just over two hours on both sides of a reel of tape. They range in price from $40 to $130, and their performance also covers as wide a range. PS found that the best machine in this class—and the heaviest—is the Norelco 101.

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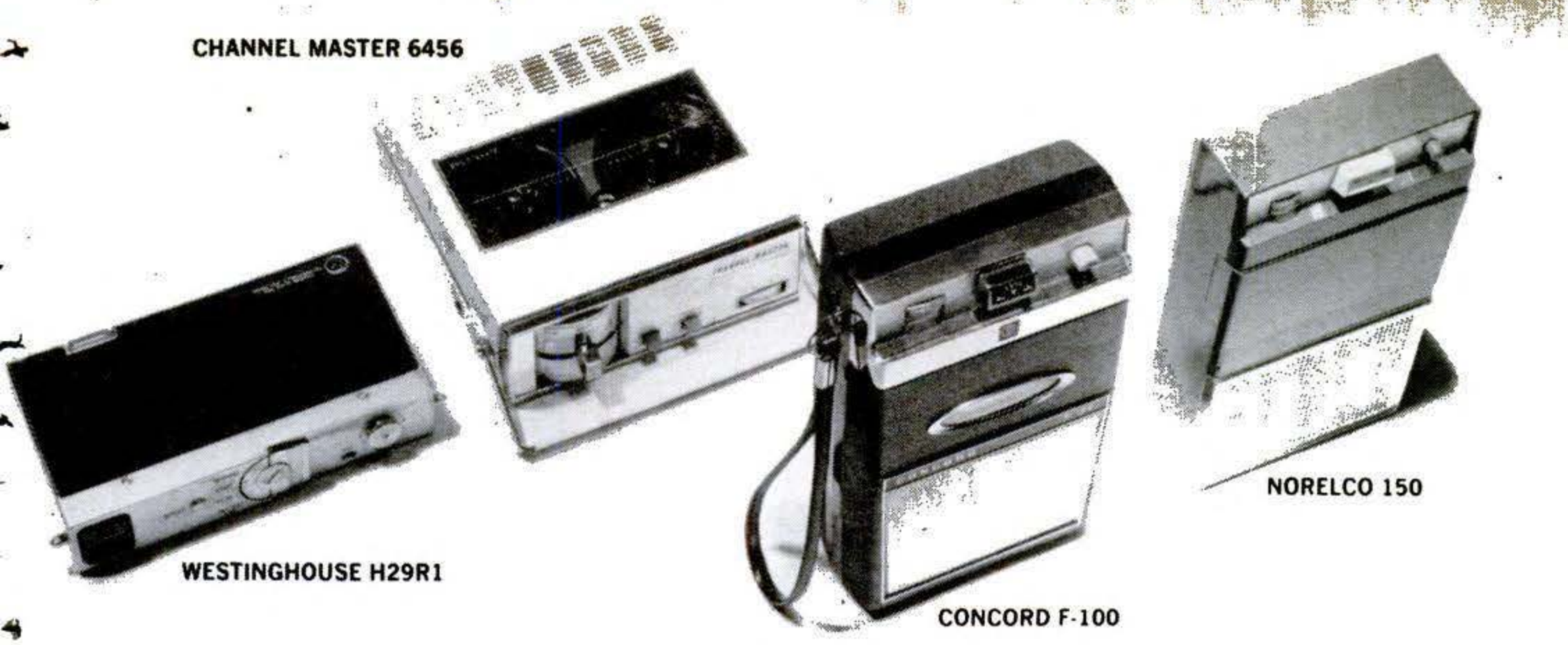

THE MIGHTY MINIATURES

All these machines use either small tape cartridges (the Norelco cassette) or tiny 2½-inch tape reels. They are small enough to fit comfortably into a coat pocket or a woman's handbag, weigh under three pounds, and cost under $100. Their maximum playing time on one reel of tape or one cartridge is about an hour. Best performer? In PS tests, the Norelco 150 and Concord F-100 tied for top honors.

THE MONSTERS

Small enough to sling over your shoulder, these recorders are still big enough to deliver good sound. PS's pick of the pack—the high-priced ($440) Uher 4000-L—will outperform many conventional hi-fi tape recorders that measure 10 times its size and weight. All take five-inch tape reels, and will hold a total of six hours of recordings (12 hours for the Uher) on one reel of tape at their slowest speed.

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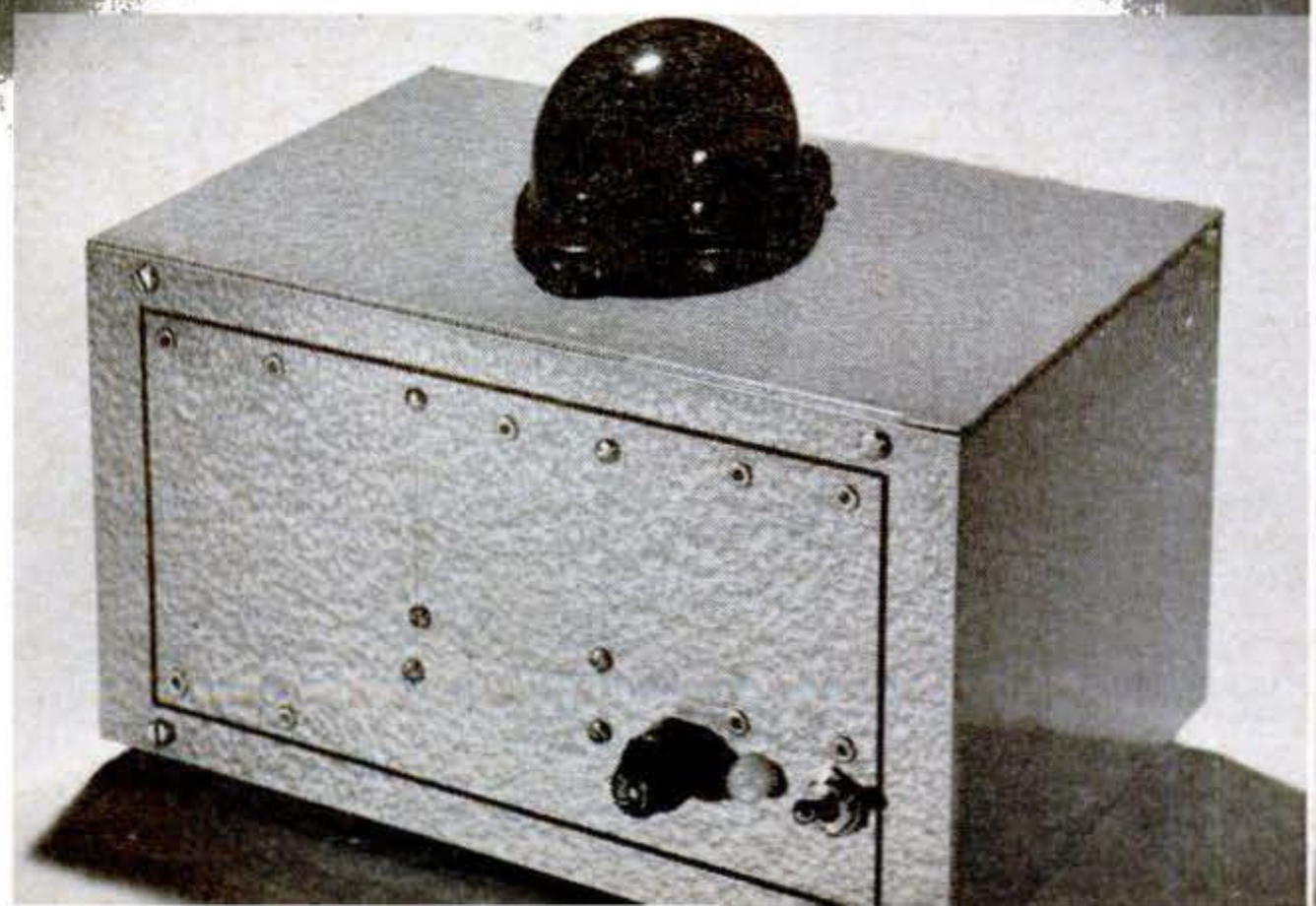
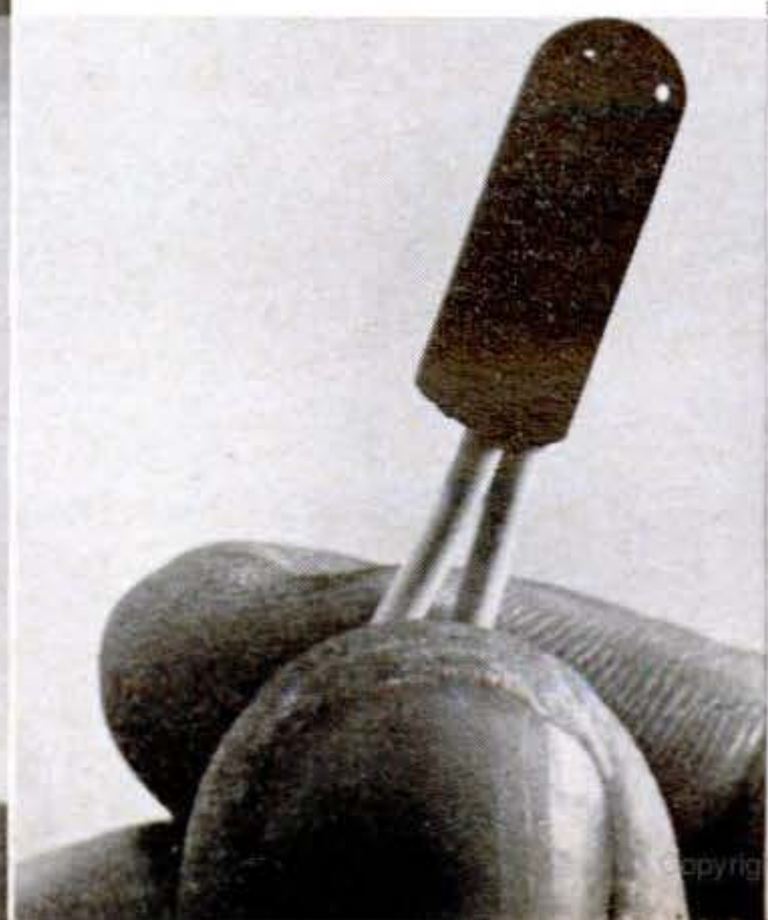
How to Build a

ILLUSTRATION BY DANA RASMUSSEN

You can connect any kind of warning signal—such as the bell shown on the device below—to the relay's contacts. The epoxy-coated thermistor (below, right) is the anticipator's temperature-sensing element. You can mount it anywhere outside your home, since it is virtually impervious to wind, snow, or rain.





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Weather Anticipator

Don't let a sudden cold wave this winter catch you with your heat down. This gadget lets you plan ahead

By RONALD M. BENREY / *PS Electronics Editor*

Sure everyone talks about the weather—but this winter you *can* do something about it. With the help of this unique electronic thermometer that warns of sudden temperature drops, you can anticipate an unexpected cold snap in ample time to turn up your thermostat. The idea is to give your heating system a head start on the changing weather so it can cope successfully with a rapid outside temperature decline. You'll live in a more comfortable house, and may save on fuel bills, to boot.

A mild winter afternoon followed by an unusually chilly evening can fool the most efficient heating system, simply because its thermostat is located inside a well-insulated house. Here's what happens:

During the afternoon, the heating system shuts off—the house's inside temperature drops very slowly because of the relatively high outside air temperature. But, as evening approaches, the outside temperature plummets and the house loses heat at an increasing rate. Eventually, the inside temperature dips below the thermostat's low setting, and the heating system comes on.

Unfortunately, many heating systems—especially hot-water and radiant-heat units—take a while to produce their maximum heat output after they have been shut off for several hours. Consequently, the inside air temperature keeps dropping. When, at last, the heating system reaches full effectiveness, it may have to run several hours at full blast to bring the inside temperature up to a comfortable level. You pay for this extra effort in higher fuel bills.

PS's weather anticipator measures the outside air temperature with a thermistor—a tiny epoxy-encapsulated chunk of semiconductor material that acts like a temperature-controlled resistor: Its electrical resistance is inversely proportional to its temperature—when the temperature goes down, its resistance goes up, and vice versa.

The unit's electronic circuit constantly monitors the thermistor's resistance. If it detects a significant, *rapid* increase—which corresponds to a rapid temperature drop—the circuit closes relay RL (see schematic diagram on next page). You can use RL's contacts to operate any kind of warning signal, such as a bell (facing page).

The "memory" unit. Heart of the circuit is a huge—both in physical size and electrical value—electrolytic capacitor, C1. This component is the anticipator's "memory"—it remembers what the temperature was several minutes earlier so the device's circuitry can decide whether or not a rapid drop in temperature has occurred. Here's how the circuit works:

Thermistor TH is part of a Wheatstone

Continued

Here's 120,000 microfarads—almost 1/8 farad—in a palm-size package. It's capacitor C1 (see schematic diagram), and serves as the anticipator's "memory."

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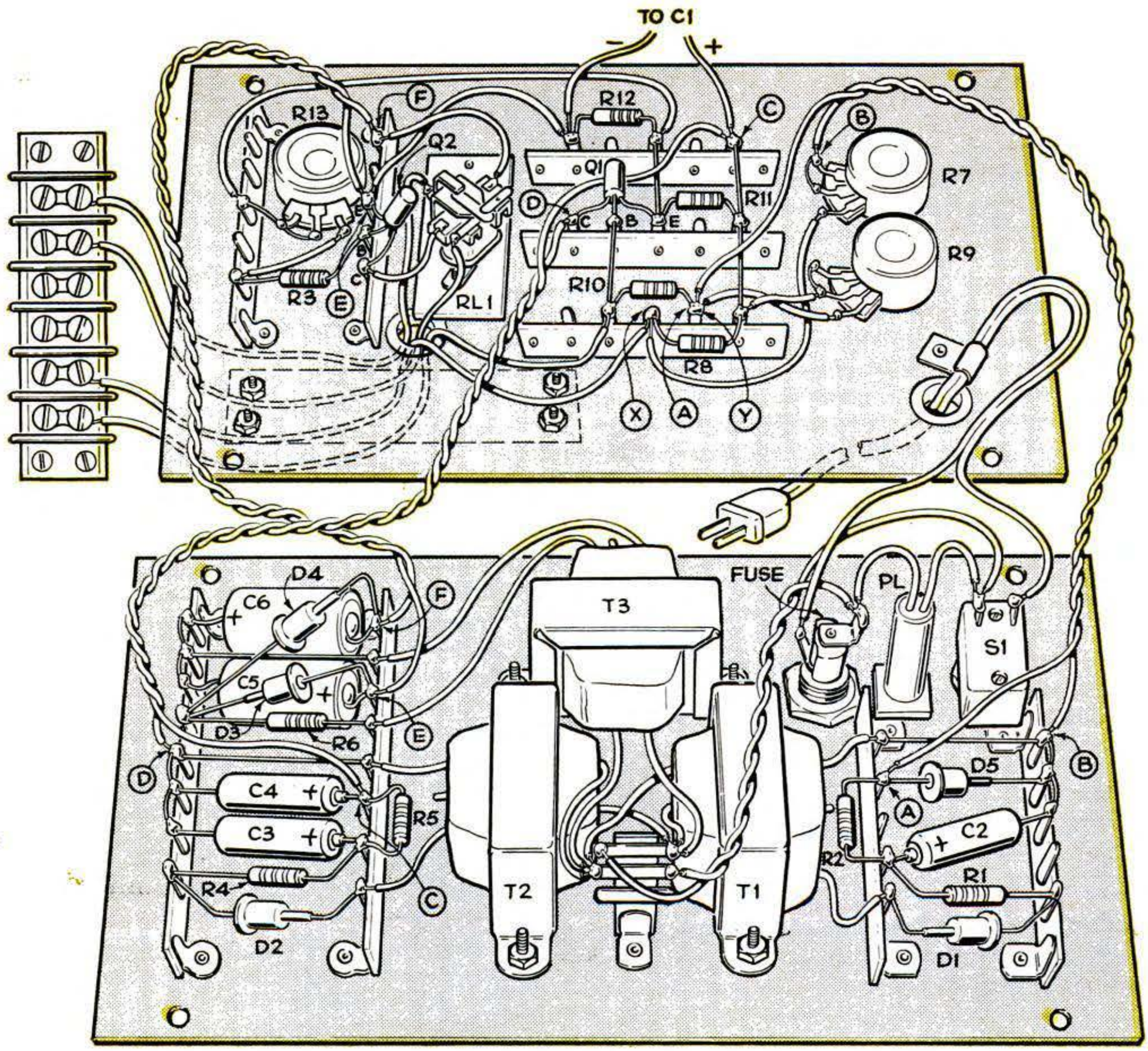

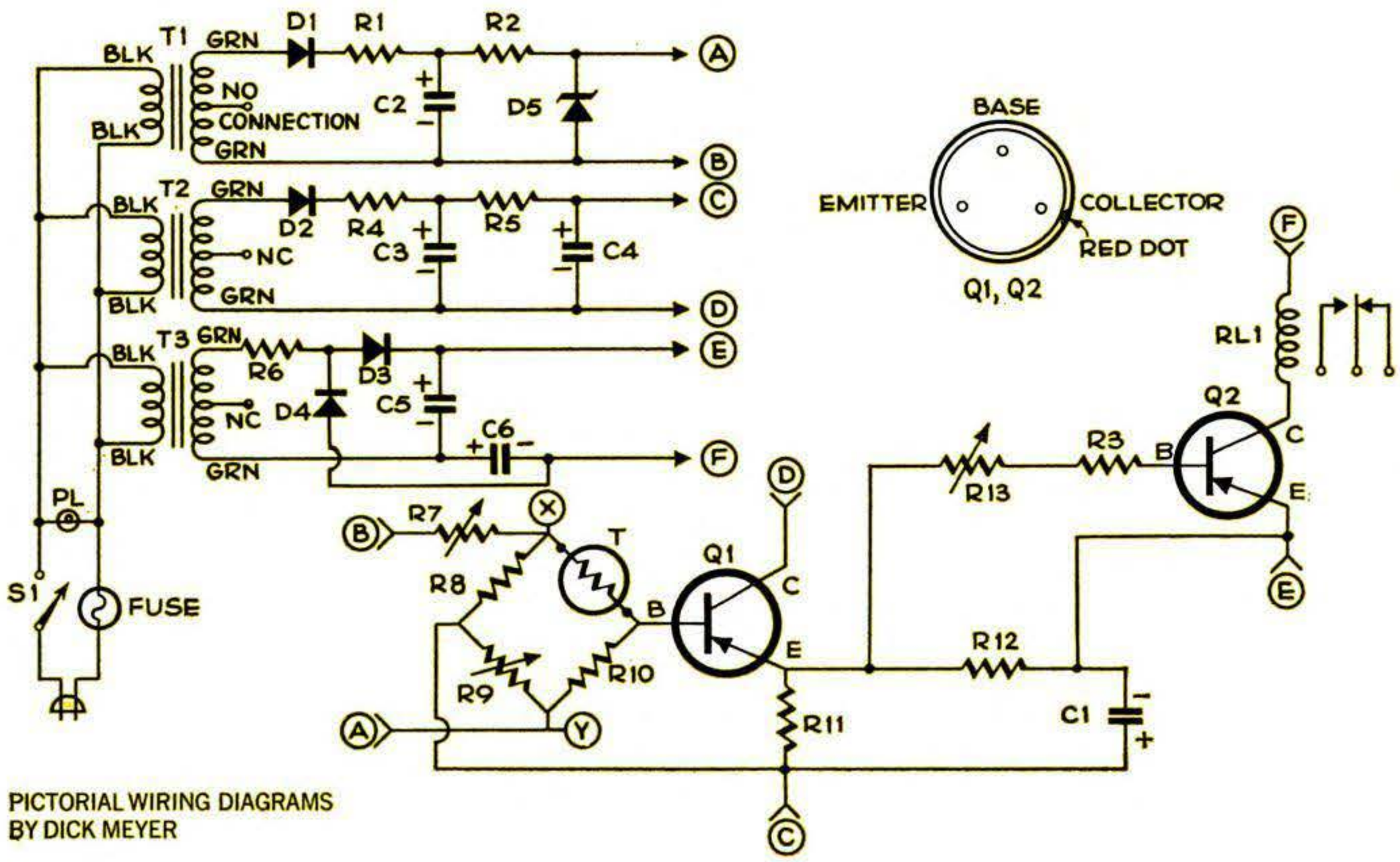

PICTORIAL WIRING DIAGRAMS
BY DICK MEYER

Now! PS lies flat on your bench or table . .

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bridge; the other legs of the bridge are R8, R9, and R10. The bridge's output voltage depends on the resistance value of TH and, hence, on the outside air temperature. Transistor Q1 is wired to form a common-collector amplifier. Its function is to isolate the bridge from the rest of the circuit; the amplifier's output voltage—the voltage measured across resistor R11—is approximately the bridge output voltage. Thus, an increase in Q1's output voltage reflects a decrease in outside temperature.

C1 is charged by Q1's output voltage through resistor R12. However, because of C1's enormous capacitance—120,000 mfd.—it takes over 20 minutes for the voltage across C1 to react to a rapid change of Q1's output voltage.

Obviously, then, by comparing the voltage across C1 with Q1's output voltage you can determine if a significant outside temperature change has occurred within the past 20 minutes.

Transistor Q2 does this job automatically. It ignores temperature increases, but instantly responds to temperature decreases by pulling in relay RL.

Note that the circuit goes into operation only if the outside air temperature is below 50 degrees and if the thermistor's resistance changes quickly—in other words, the device reacts to abnormal temperature drops, on winter days only. By adjusting the sensitivity control, R13, you can select the degree-per-hour temperature drop that will trigger the device. The circuit's range is from approximately 10 to 30 degrees per hour. You'll have to experiment to find the best adjustment for your location and heating system. Start with the most sensitive setting (minimum resistance) of R13, and increase its value until the device no longer responds to normal temperature drops that your heating system can handle easily.

Building it. Use an aluminum utility case as an enclosure. Mount all components except electrolytic capacitor C1 on the front and rear panels; use a capacitor mounting bracket to secure C1 inside the case.

Mount several terminal strips on the panels, as shown in the pictorial diagram (left), to serve as soldering points and mounting points for the smaller components.

Mount RL on a scrap of fiberboard or plastic to insulate it from the case.

All of the capacitors used in this circuit are electrolytic, so double-check the polarity of each before you solder it in place. Do the same when you mount the five diodes—be sure you don't overheat them or the two transistors, Q1 and Q2, when you solder their leads.

The thermistor is supplied with two precision resistors—they are not used in this circuit, so you can discard them.

Calibration. You'll need a 0-5-volt DC voltmeter (the voltmeter range on your volt-ohm meter is fine) to calibrate the circuit.

The first step is to connect the meter to test points X and Y (indicated on schematic diagram) with the positive meter terminal going to point X. Next, disconnect TH from the circuit, set R9 to its minimum resistance value, and adjust R7 for a meter reading of four volts.

To complete the second calibration step, connect the meter across resistor R11 (negative meter terminal goes to emitter lead of Q1). Reconnect the thermistor, and place it in a bowl of water whose temperature is exactly 50 degrees—use a darkroom thermometer to check the temperature. Finally, adjust R9 for a minimum meter reading, after waiting a minute or two for the temperature of the thermistor to stabilize. PS

PARTS LIST

R1—10-ohm, ½-watt carbon resistor
R2, R5—100-ohm, ½-watt carbon resistor
R3—100,000-ohm, ½-watt carbon resistor
R4, R6—22-ohm, ½-watt carbon resistor
R7, R9—2,000-ohm, linear taper carbon potentiometers
R8, R10, R11—1,000-ohm, ½-watt carbon resistor
R12—10,000-ohm, ½-watt carbon resistor
R13—250,000-ohm, linear taper carbon potentiometer
C1—120,000-mfd., 6-volt electrolytic capacitor (Sprague 36D-124-G-006 DC)
C2, C3, C4—100-mfd., 15-volt electrolytic capacitors
C5, C6—50-mfd., 15-volt, electrolytic capacitors
T1, T2, T3—6.3-volt AC @ .6-amps filament transformers (Stancor P-6465)
RL—Sigma 11-F SPDT DC relay, 2,300-ohm coil
Q1, Q2—2N408 PNP transistors
D1, D2, D3, D4—GE 504 silicon rectifiers
D5—6.2-volt, 1-watt zener diode (any voltage rating between 5.5 and 6.5 volts will work)
S1—SPST toggle switch
PL—neon-bulb pilot lamp assembly with built-in resistor
Fuse—1-amp fuse in holder
TH—GE type X-15 thermistor
Misc: Aluminum universal case 6" x 9" x 5"; terminal strips; line cord; hardware

. New "Perfect Binding" makes easy reading

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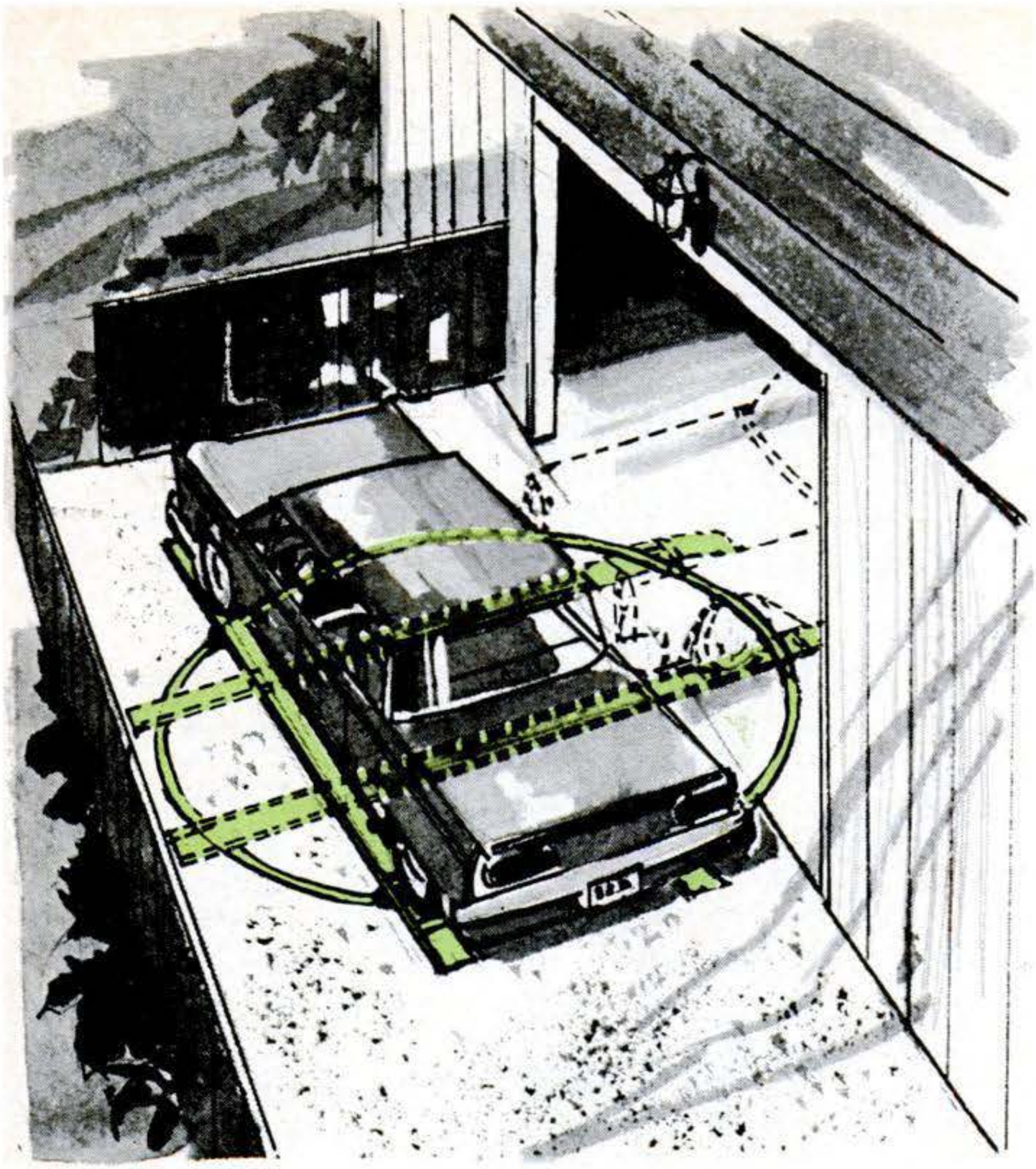
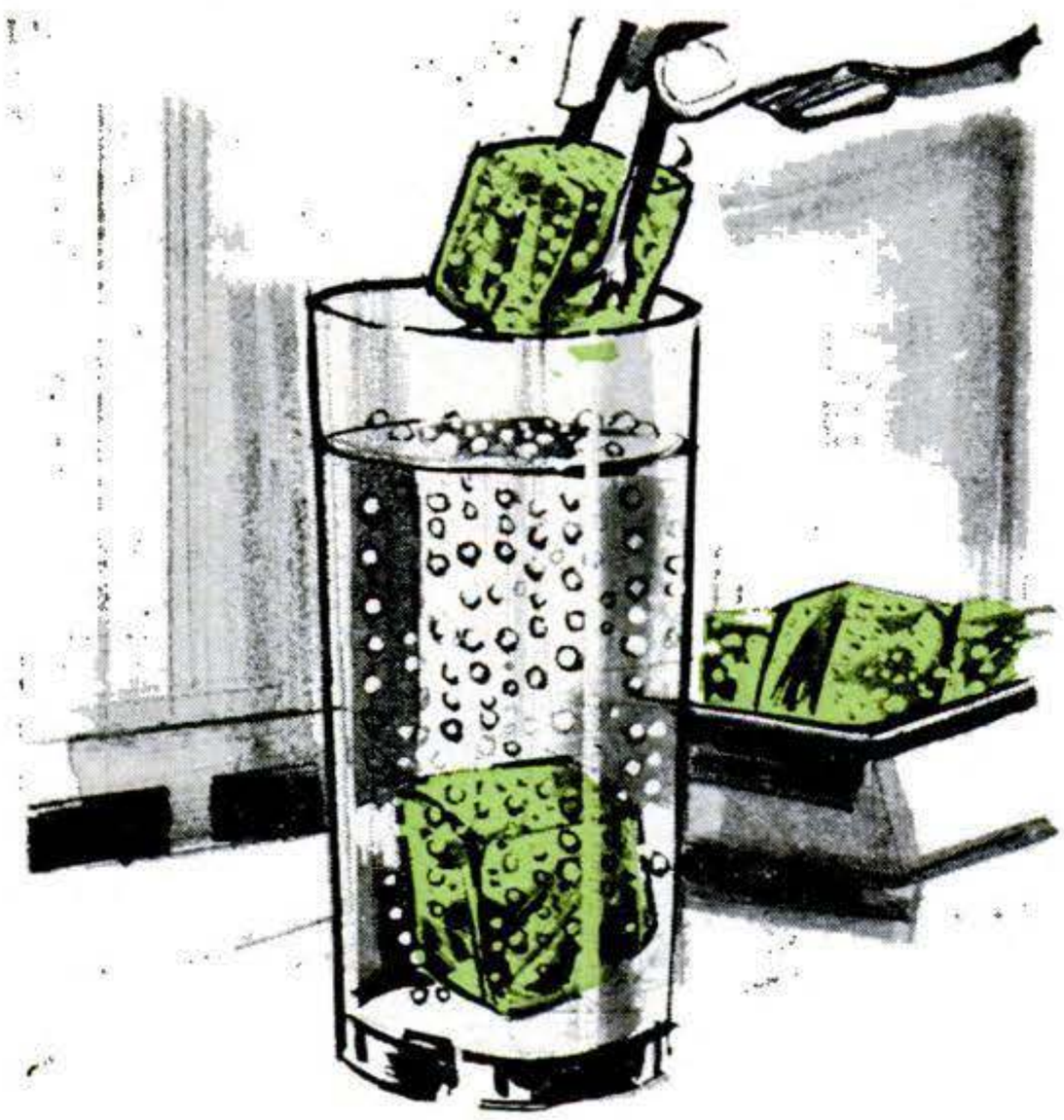


New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMORE

Lazy Susan eases parking. You could swing a car 180 degrees under its own power on this recently patented turntable to ease big cars into small garages or make better use of driveway space. You'd drive onto flanged tracks on a circular rail. The car's drive wheels, turning against rollers in the tracks, would rotate the turntable one way in forward gear, the other in reverse. At a preset stop the tracks would lock so you could drive off.



Ice cube puts fizz in drink. Mixing water and liquid carbon dioxide under pressure, according to this General Foods patent, makes carbonated ice that can be stored in a refrigerator. Added to flavored water, the ice would produce instant cold soda. Added to a carbonated drink, the trapped-in fizz would keep the drink fresher by increasing, rather than diluting, carbonation, as ordinary ice cubes do.

Hot watch gives silent alarm. Drawing power from two self-contained batteries, a porcelain-cased metal plate at the back of this watch would heat up, for up to 30 seconds, to wake the wearer with a burning sensation. The soundless alarm wouldn't disturb others, and might be especially effective for the hard-of-hearing. During the day, the otherwise conventional watch could alert you for appointments.

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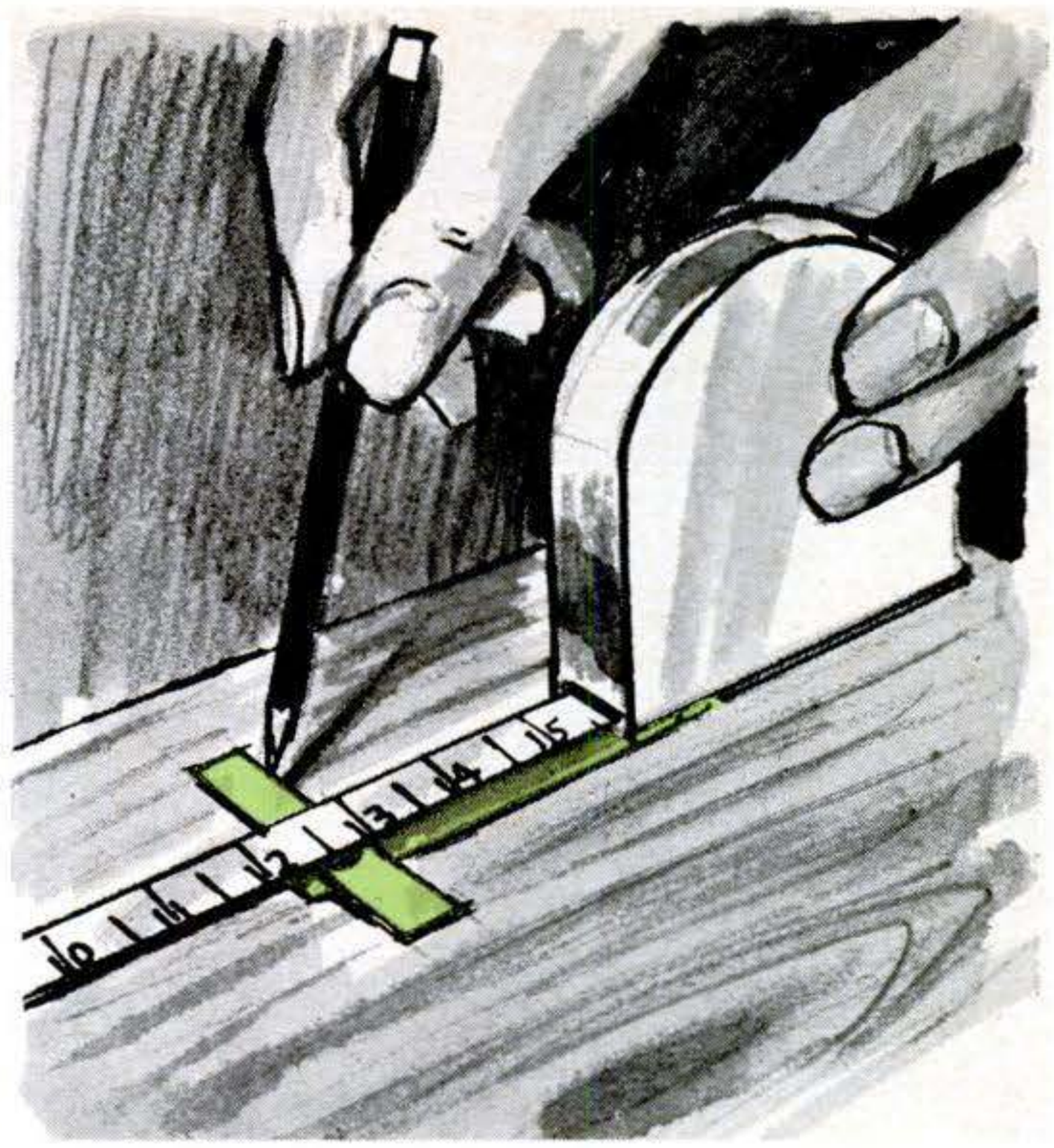
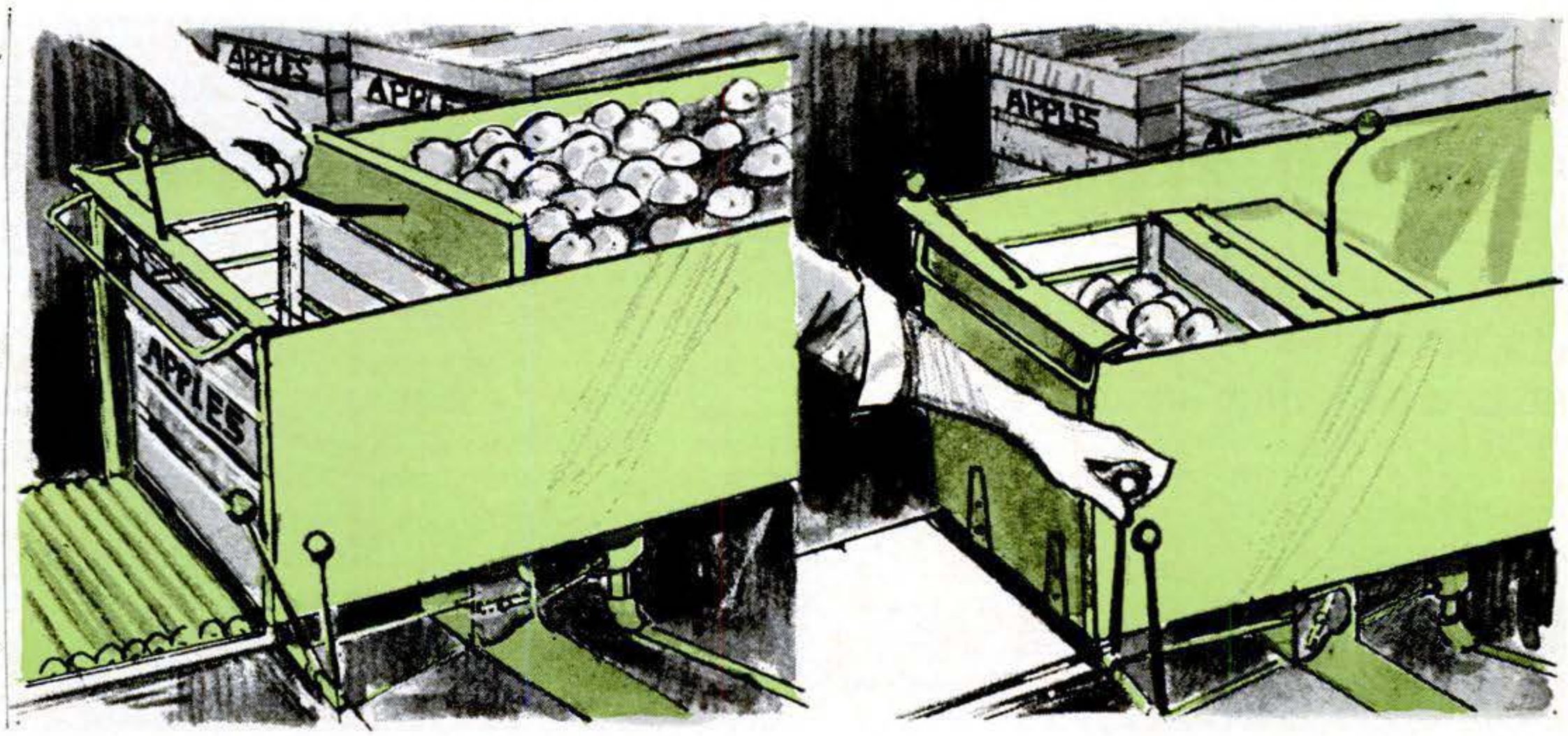
Wrist brace steadies pistol. Extending from the handle of a pistol, this stabilizer is designed to grip and steady the forearm so that wrist motion is kept to a minimum during aiming. The bracket would also help resist the upward kick when the gun is fired. It could be made as a fold-out from a special pistol grip, or as a screw-on attachment that would fit most guns.



Clip-on accessory marks straightedge. Snapped onto the bottom of the housing of an ordinary steel tape, this swing-out attachment would hold the tape against its retractor spring at any extension and would serve as a straightedge—or a T square—for marking the work. When not needed, the pivoted extender and crossarm could be folded under the case, or slipped off.



Water loader protects fruit. Fruit and other produce could be crated gently but rapidly by floating it down a water-filled trough into a water-filled box or carton. Gating the trough and letting water out of the bottom of the crate would then lower the individual pieces into their shipping box and pack them in compactly but with comparatively little bruising.

The following patents have been issued on these inventions: **Turntable**—*No. 3,170,411 to G. Howard, Jackson, Mich.;* **Fizzed ice**—*No. 3,255,600 to W. Mitchell, Lincoln Park, N.J.; H. Barnes, Rockland County, N.Y., and H. Schwartzberg, Hartsdale, N.Y.;* **Watch alarm**—*No. 3,255,582 to J. Zam, Ft. Macleod, Alberta, Can.;* **Pistol brace**—*No. 3,184,877 to W. Andrews, Metairie, La.;* **Straightedge**—*No. 3,181,242 to R. Cook, Racine, Wis.;* **Packer**—*No. 3,178,867 to W. Martin, Grand Island, N.Y.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commisioner of Patents.

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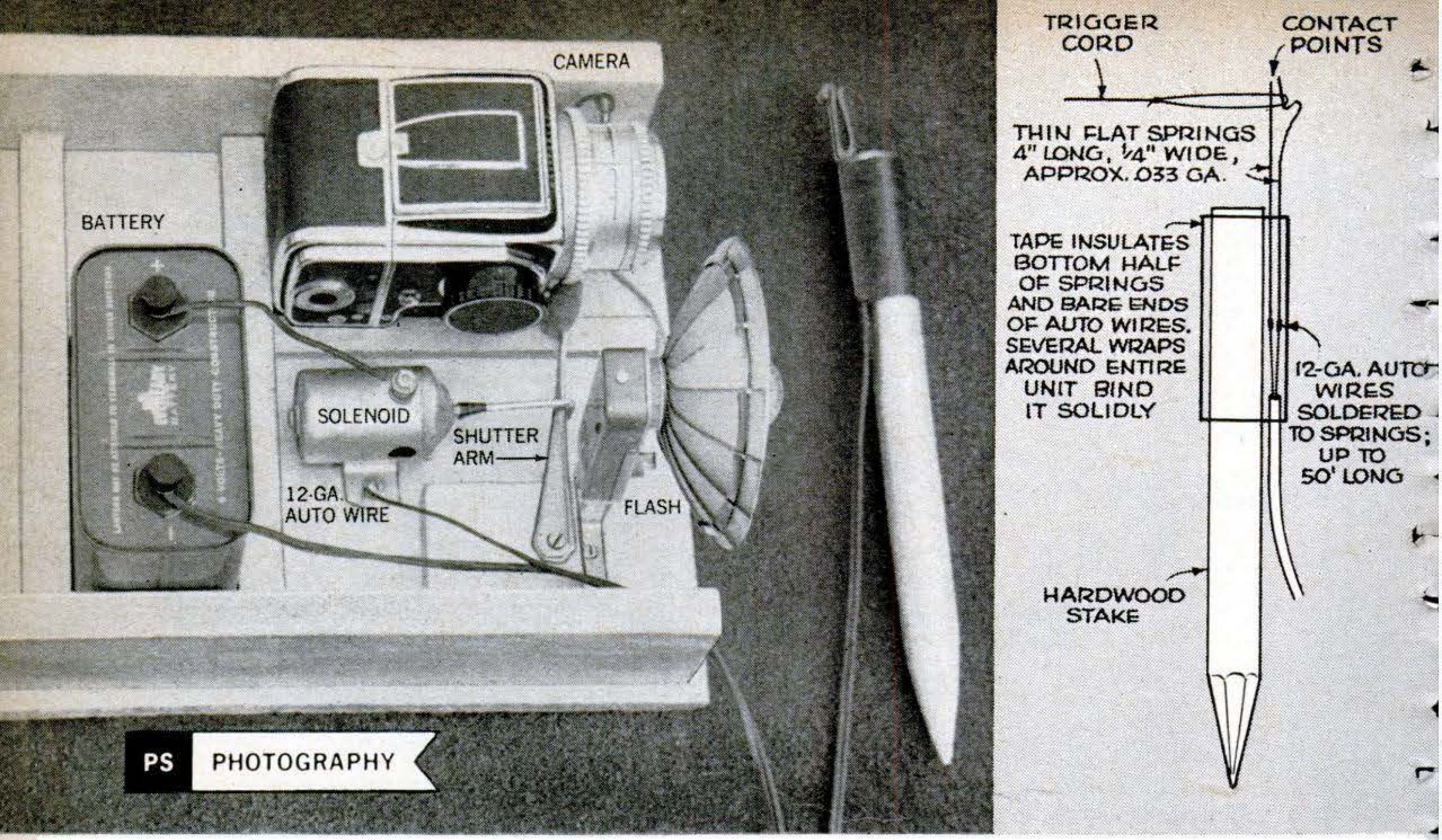

Simplicity of design of Ed Cesar's photo trap makes it easily adaptable to any camera and flash. A cover, with front cutouts for lens and flash, protects it from the elements. Handle on cover (photo on facing page) makes unit portable. A slight pull on the trigger cord draws the contact points together, closing the circuit through the six-volt battery to the solenoid. The solenoid extension then pulls back a pivoting arm that presses the shutter-release button on the camera. A block of soft rubber cushions the action. Solenoid is from an old Ford starter unit; the extension hook was welded on.

Photo Trap Lets You Bring 'Em Back

Relax, while this simple device sits up nights to catch those once-in-a-lifetime animal shots

By ED CESAR

Letting a wild animal take its own picture is a lot easier than spending long hours in a cold blind or stalking it through the woods. I know. I've tried both ways.

For years, I live-trapped wild animals for zoological purposes, and steel-trapped them for their pelts. From this experience, when I became a professional photographer, came the conviction that if I could lure an animal into a trap or snare, I could just as easily entice it into setting off a triggering device that would take its picture.

Now my camera and flash sit up nights while I sleep. The photo-trap unit is as easy to carry as a small suitcase. Except for the lens and flash, it is totally enclosed for protection against the weather.

I camouflage the unit with grass, brush, dirt, or snow—whatever is handy—and I try to leave the area as untouched as possible to keep my subjects from getting suspicious.

A well-traveled snowshoe-hare trail in snow can produce fine picture results. Predators often move along these in search of prey. Equally good are big-game trails leading to water holes and mineral licks, or avenues of approach to a den or burrow. Or bait can be tied directly to the cord.

I set out my trigger cord (white on snow, gray on barren ground) across the trail, usually suspending it about an inch above the surface and attaching it to some brush or other anchor. Then I attach the cord to the contact points of my stake and cover the stake, plus the wiring leading to the camera unit, lightly with grass. I set the camera off a short distance from this

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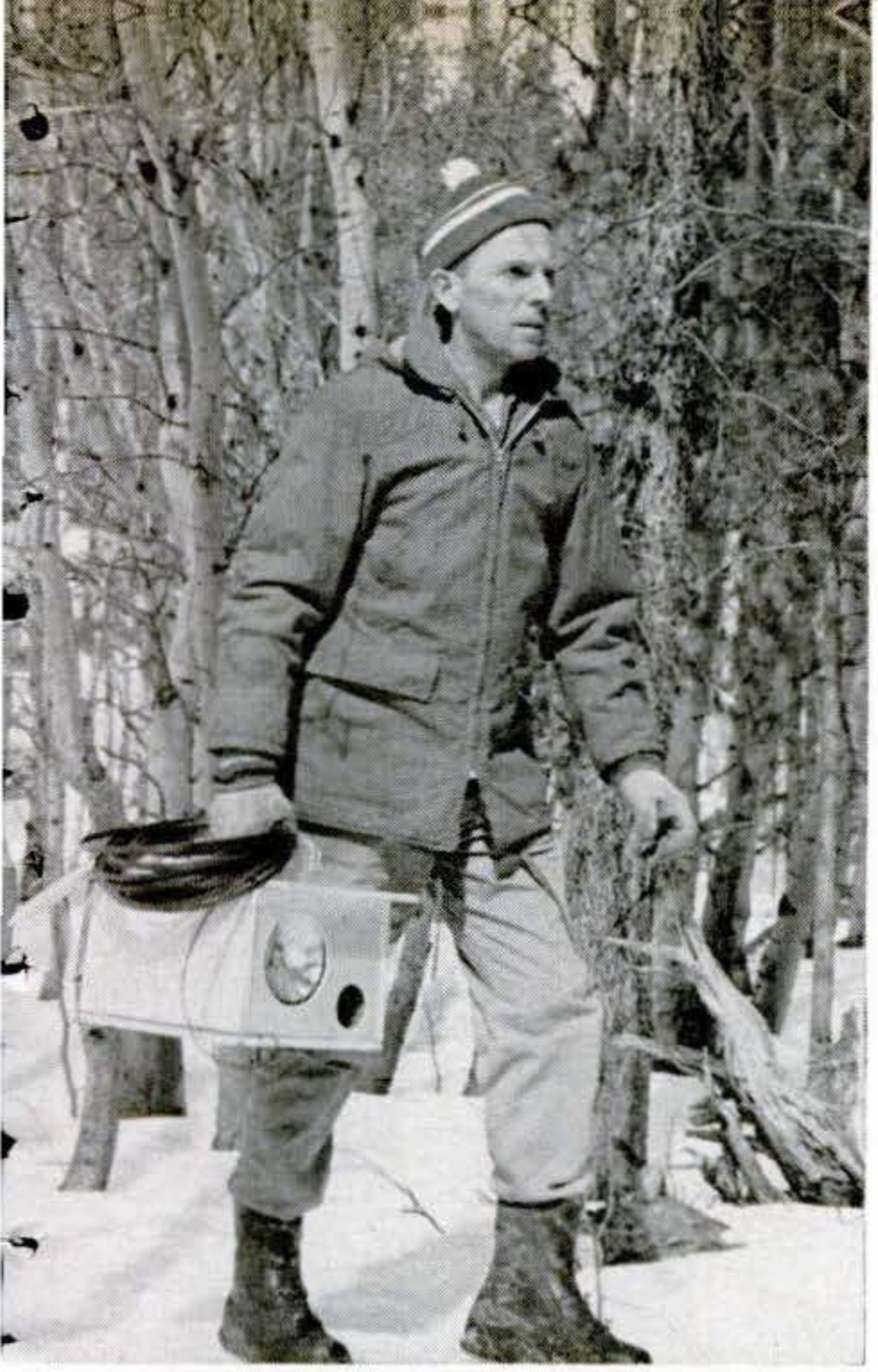
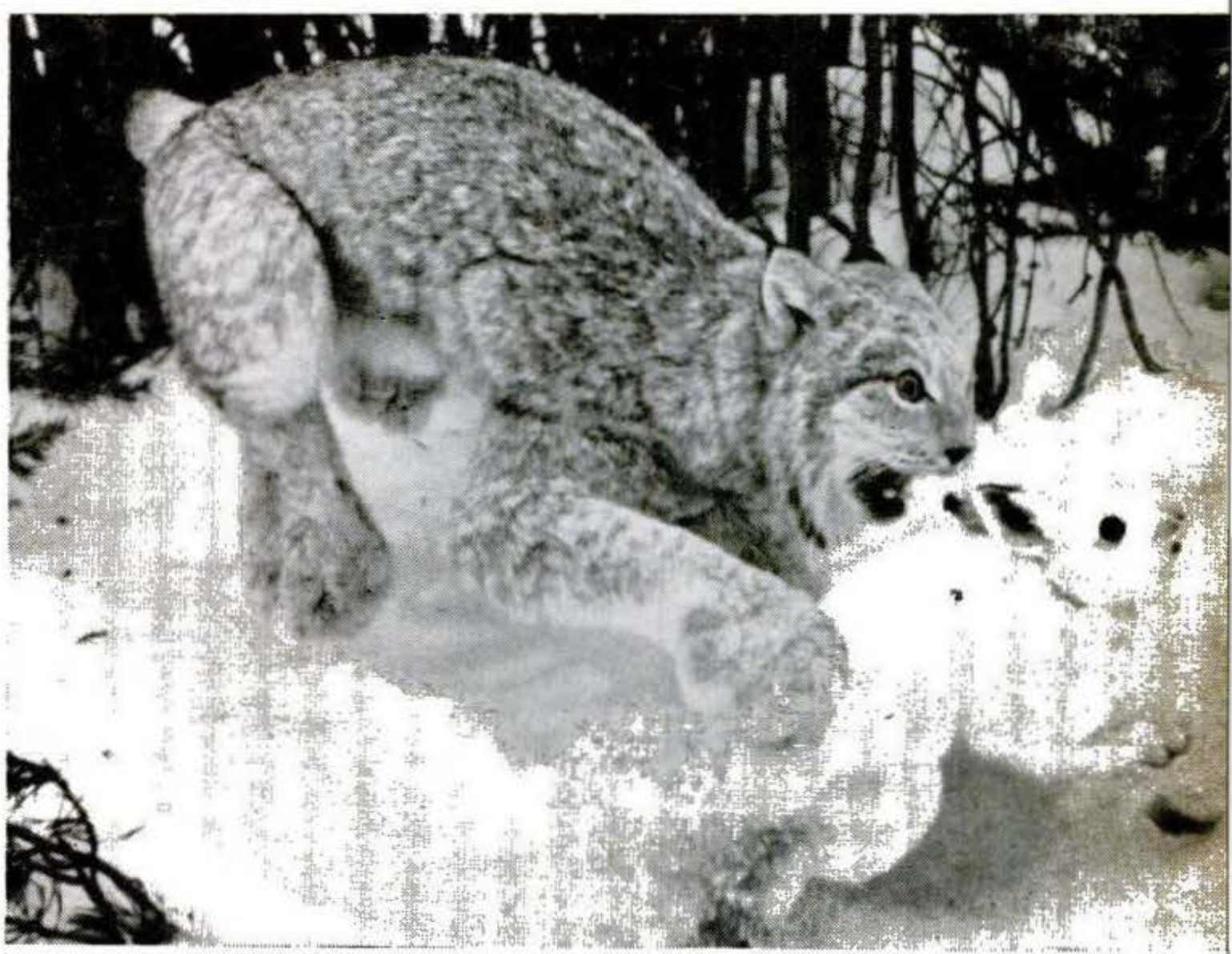


Photographer Ed Cesar sets off to place his photo trap in frozen Canadian woods. Auto wire is coiled in his hand. Trigger cord, not shown, should be just strong enough to make contact, break under further strain. At right: three Cesar photos.

Busy beaver takes its picture while cutting down a tree.



Lynx pounces on hare that stopped on trail to nibble.

Coyote, victim of cyanide gun, snaps own death scene.

in Pictures

point and focus it on the trail area around the cord.

The distance of camera to trail depends on the size of my subject. For small game, I set it a few feet away. Big game—moose, elk, deer—call for a larger view, and hence a greater distance from the cord. I also set the cord up higher, so small animals can pass beneath.

Because an animal may be moving fast when it triggers my camera, and in semi- or total darkness, I use a film of at least 160 ASA, flash bulbs of at least Press 25 size, and a shutter speed of 1/250 second or faster.

In severely cold weather, of the kind we get here in Alberta, I make sure that my camera is winterized and that my batteries—both for the solenoid and flash—are fully charged.

AT LAST: ROLLEI HAS

And there's hot news from other makers of camera equipment, too

By **EVERETT H. ORTNER** / *PS Photography Editor*

Hasselblad, Bronica, and other 2½-by-2¼ single-lens-reflex cameras can move over now. Franke & Heidecke, the people who put a Rolleiflex twin-lens reflex camera into the hands of virtually every professional photographer, now hope to repeat their success with a single-lens 2¼-inch reflex, the Rolleiflex SL66.

The old Rollei twin-lens—one of the great classic cameras—will still be made and sold. But the winds of change have somewhat outmoded it. Interchangeable lenses is what the customer asks for today, and what the old Rollei, except by cumbersome attachments, can't supply. The camera that replaced the four-by-five press camera found itself replaced.

The new Rollei, introduced at the Photokina exhibition in Germany in October, will have everything:

- A lens board that tilts—up to eight degrees—just like a press camera.
- Integral bellows that extend up to 50mm for close-up photography.
- Lenses that reverse—a 50mm Zeiss Distagon and an 80mm Zeiss Planar—to enlarge the image even more.
- Rubberized-cloth focal-plane shutter.
- Quick-return mirror.
- Interchangeable focusing screens, interchangeable film magazines, interchangeable lenses (50mm to 1,000mm).

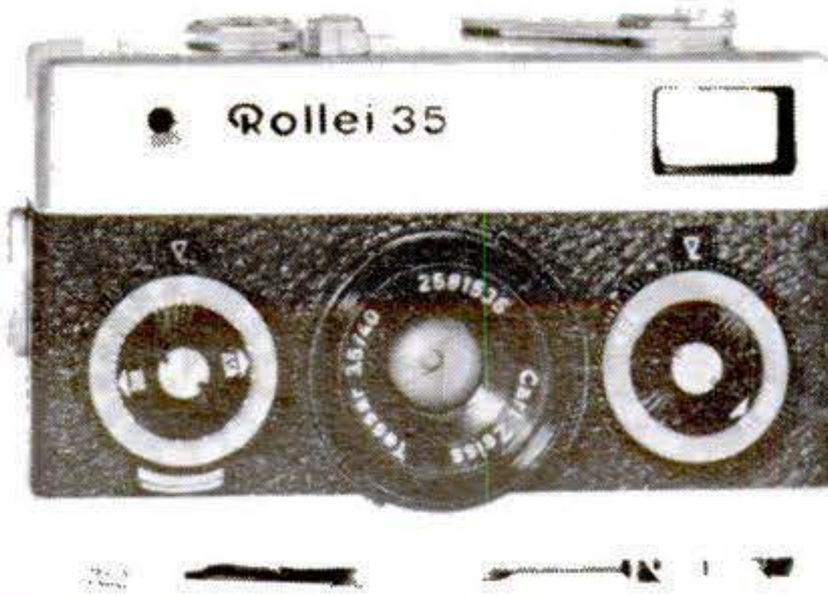
Coming up: a through-the-lens exposure meter and a prism viewfinder.

The Rollei SL66 will be on sale in the U.S. next spring. Price: not announced.

Other equipment in the news:

- A little Rollei 35, also introduced at Photokina. Tiny—less than four inches long by 2½ high—the camera will slip into your coat pocket. It will be available next summer. Price: not announced.
- The Linhof 220, designed to shoot the so-called "ideal format" (2¼ by 2¾ inches; enlarged, the picture fits just about right on an 8-by-10 sheet). It takes either 220 film—that's a double 120 roll—or 120.
- Fujica's new Single-8 movie camera, the Z-2. A variable shutter control permits fade-ins and fade-outs; a reversing mechanism makes lap dissolves possible.
- Kodak's new M65 movie projector. It takes either Super 8 or the old double-8 film and sells for a very low $100.

Kodak M65 Super 8 movie projector takes either Super 8 film or old double-8. Moving a lever changes it from one format to the other. A special hub on the supply spindle adapts it to Super 8. Other features: fully automatic threading (onto the take-up reel), automatic power rewind, sprocketless film transport, tilting optical system to permit raising picture without raising the projector itself. Weight: 9¼ pounds.



Rollei 35 is a precision-made camera for amateurs. Its short-focal-length lens—40mm, almost a wide-angle—provides exceptional depth of field. Lens: f/3.5 Zeiss Tessar. All controls can be read and set from above. Other features: shutter speeds from ½ to 1/500 second, built-in light meter with match-needle exposure control.

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AN SLR

Rolleiflex SL66 has integral bellows that increases lens extension by 50mm. Extension and scale of reproduction are shown on bellows (above). With lens reversed (left), up to 3:1 reproduction is possible with 50mm lens—three times actual size. Other features: crank-operated film transport and shutter cocking, pneumatic brake to cut noise of quick-return mirror, shutter speeds from one to 1/1,000 second, quick-change magazines.

Fujica Z-2 Single-8 movie camera makes smooth scene transitions with lap dissolves or fade-outs. At end of a scene, you wind back film enough to double-expose start of next scene. Or, with variable shutter control, you slowly darken (fade out) picture, then slowly lighten (fade in) next scene. Camera sells for $200.

Linhof 220 still camera, designed for professional photographers, is made to be used vertically. It shoots 2¼-by-2¾ negatives. Rapid-advance lever, on side, advances film and cocks shutter. Shutter speeds go up to 1/500 second. Lens is a 95mm Technikar. Price: not announced.

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Which SNOW

Scrappy little lightweight models are the big news this winter

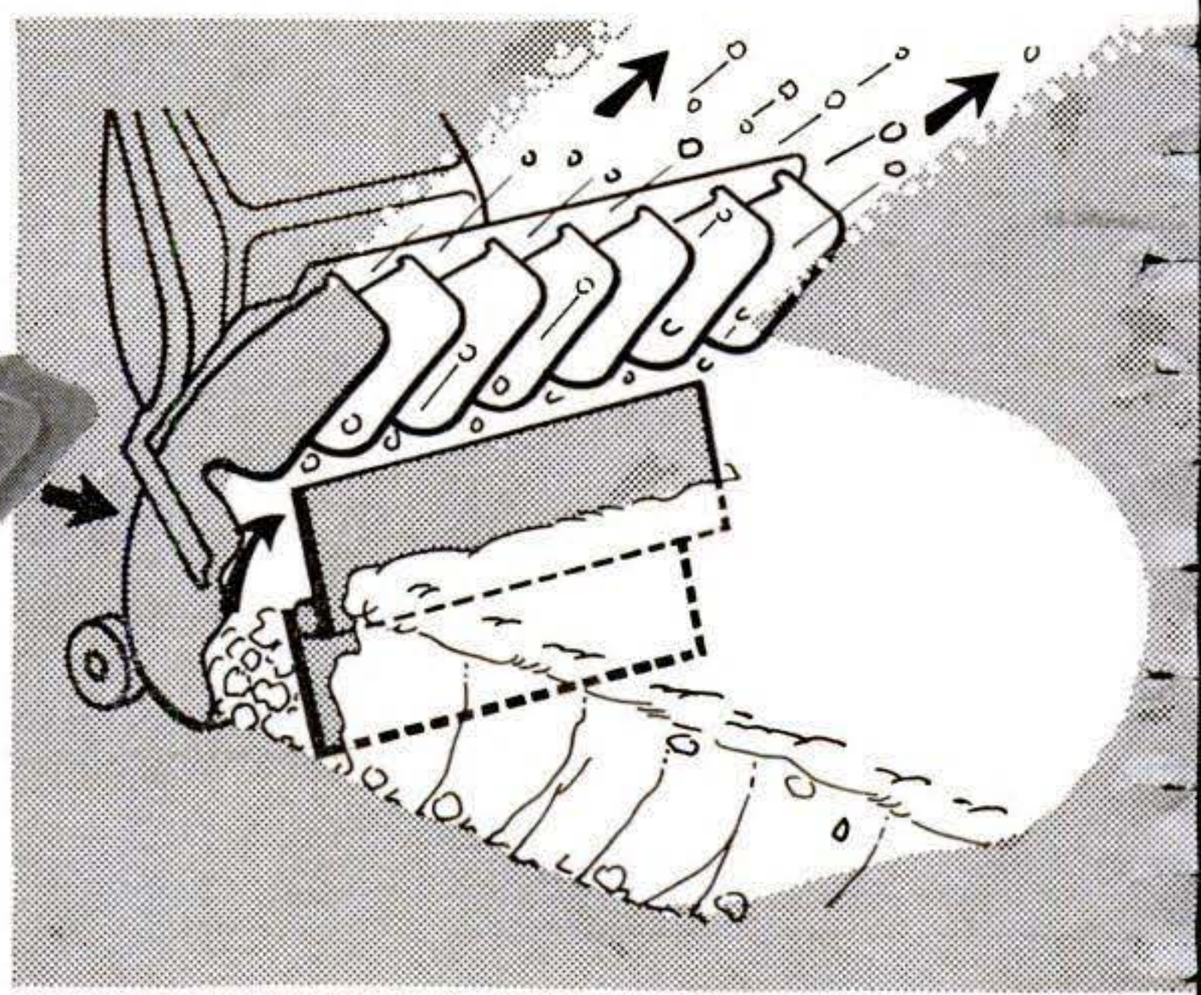
For less than $100, you can buy a snow thrower that handles jobs a $1,000 machine would have trouble doing. Like clearing off the front porch and steps. Or scooping the snow out from under a car caught in a drift. Or even clearing off a low-pitched roof. The thrower handles ordinary jobs like walks and drives, too. And when the job's done, you hang the machine on the wall, out of the way till the next snow.

What snow thrower can do all this? Any of several new lightweights. These machines got their start in 1964 when Toro introduced its Sno Pup. The lightweight plastic paddle and fin design cost less to produce and worked like a charm. The Sno Pup proved so popular that Toro expanded its paddle line to three models. Sears, AMF, and others have followed with similar machines.

What makes these lightweights so popular? They're usually priced around $100. They weigh under 30 pounds (the Toro electric weighs 20)—so they're easy to handle.

They're versatile. You can roll them along the ground to clear drives and walks, or pick them up by the two-level handle and

AMF Husky Jr. is so light you can pick it up like a snow shovel to tackle big drifts. It's powered by a two-cycle chain-saw engine.



Toro started lightweight trend in '64. At right is their new 20-pound electric. Drawing shows how Toro and other paddle machines throw snow, direct it by means of plastic fins.

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THROWER Should You Buy?

Gilson, like other big units, is designed to take on the deep drifts. It has two gears forward, two reverse for easy handling on hills and in heavy snow.

Sunbeam electric snow thrower is never a problem to start—plug it in and flick the switch. It has a headlight for night use, a Teflon-coated chute.

use them like a power shovel. They'll handle an average snowfall with ease, and can tackle an occasional heavy drift.

Not all lightweights use the paddle design. The Little Wonder uses a finned disk like those on big rotary highway plows. It's run by a gasoline powerhead that also attaches to the Little Wonder cultivator. Both tools are made by Little Wonder, Inc., 1028 Street Rd., Southampton, Pa.

Lightweights are not the answer to every snow-removal problem. Maybe your needs

Continued

Sensation Debonair Sno Blo is another approach to a lightweight machine. This one uses a high-speed fan to throw snow right, left, straight up, or ahead.

Little Wonder throws snow by means of a 10" finned disk. You can slide this machine along the ground or pick it up to do the steps and porch.

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FACTS AND FIGURES ON TH

MAKE AND MODEL		APPROXIMATE PRICE	HORSEPOWER	WEIGHT (lb.)	WIDTH OF CUT (in.)	TYPE OF IMPELLER				HAND-PUSH	SELF-PROPELLED	FWD. GEARS	REV. GEARS	ENGINE		
						Single Stage	Two Stage	Auger	Paddle					2-cycle	4-cycle	Elec.
ALLIS-CHALMERS	SNO-BEE 4	$260	4	210	23½	√		√			√	1	1		√	
	SNO-BEE 6	$330	6	244	26	√		√			√	2	2		√	
AMF WESTERN TOOL	HUSKY JR.	$100	2	28	14	√			√	√		0	0	√		
	HUSKY 1360	$270	4	242	26	√		√			√	4	0		√	
	POLAR BEAR 1361	$350	6	275	26		√	√			√	4	0		√	
ARIENS	10M-4 SNO-THRO	$250	4	250	24		√	√			√	4	1		√	
	10M-5 SNO-THRO	$280	5	262	24		√	√			√	4	1		√	
	10M-6 SNO-THRO	$310	6	262	24		√	√			√	4	1		√	
	10M-6D SNO-THRO	$330	6	262	24		√	√			√	4	1		√	
ATLAS TOOL	SN18P ATLAS AIRE	$130	3	101	18	√		√			√	1	0		√	
	SN418 ATLAS AIRE	$150	4	117	18	√		√			√	1	0		√	
BERBRO	#150	$230	3	200	20		√	√			√	4	1		√	
	#360	$260	4	250	23		√	√			√	4	1		√	
	#400 VIKING	$330	6	310	26		√	√			√	4	1		√	
BOLENS	ARTIC 40	$198	4	155	22	√		√			√	1	0	√		
	ARTIC 60	$330	6	250	26	√		√			√	2	2	√		
BRYANT	930 SNOWLINE	$1100	9.2	650	30-38		√	√			√	3	1		√	
GILSON	827	$300	5	290	26		√	√			√	2	2		√	
	820	$340	6	305	26		√	√			√	2	2		√	
HABAN	30813	$330	6	234	24		√	√			√	5	5		√	
	30814	$350	6	247	30		√	√			√	5	5		√	
HAHN-ECLIPSE	SNOW GIANT 584-5	$320	5	254	24		√	√			√	4	1		√	
	SNOW GIANT 588-6	$360	6	278	28		√	√			√	4	1		√	
HUFFMAN	SNOW WOLF 4628	$206	4	170	22	√		√			√	1	1		√	
HUNTER	62-20	$230	3	205	20		√	√			√	var.	0		√	
	62-24	$275	4	272	24		√	√			√	var.	0		√	
	62-624	$330	6	277	24		√	√			√	var.	1		√	
	62-28	$365	6	302	28		√	√			√	var.	1		√	
JACOBSEN	52003	$220	3.5	150	20	√		√			√	1	0	√		
	52601	$330	6	235	26		√	√			√	4	1		√	
JARI	2-WAY W-2	$200	3	161	20	√					√	1	0		√	
	CHAMPION H	$264	4	170	20	√					√	1	0		√	
LAMBERT	HS-20	$230	3	205	20		√	√			√	var.	0		√	
	HS-245	$240	4	220	24		√	√			√	var.	0		√	
	HS-240	$280	4	272	24		√	√			√	var.	0		√	
	HS-628	$340	6	293	28		√	√			√	var.	1		√	
	HS-325	$370	6	307	32		√	√			√	var.	1		√	
	HS-40	$900	10	495	40		√	√			√	var.	1		√	
LAWNMASTER	620	$100	3	95	15	√		√		√		0	0		√	
	621	$180	3	120	18	√		√			√	1	0		√	
	622	$220	4	135	20	√		√			√	1	0		√	
	623	$365	5	233	24		√	√			√	1	1		√	
	624	$400	6.25	243	24		√	√			√	2	1		√	
LAZY BOY LAWN MOWER	SP17-65	$140	3	95	17	√		√			√	1	0		√	
	DLB-65	$180	4	115	20	√		√			√	1	0		√	
LITTLE WONDER	7003	$120	1	N.A.	10	√				√		0	0	√		

Note: Chart contains information on self-contained units only. No tractor attachments are included. N.A.—not available.

dictate a bigger machine. Medium-weight machines are a better choice in areas of fairly heavy or frequent snowfall. They'll handle a pretty big job, but they aren't too heavy for the average home owner to manage. Smaller models are usually single-stage hand-push models. Bigger ones are mostly two-stage (an auger chops and gathers snow, a fan blows it away) and most are self-propelled—a big advantage on hilly terrain and big jobs.

Heavyweights are usually sold to professional snow-removal outfits and to people with very long drives or other large areas like parking lots. Sometimes several neighbors pool their money and buy a big machine to get the heavy-duty performance at light-duty prices.

Garden-tractor attachments cost about the same as medium-weight units, but they can do the work of a heavy unit. Riding a tractor can be a real advantage when you have a large area to clear. Some tractors have canvas canopies to protect you from the cold.

When you have decided what size is

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1967 SNOW THROWERS

MAKE AND MODEL		APPROXIMATE PRICE	HORSEPOWER	WEIGHT (lb.)	WIDTH OF CUT (in.)	TYPE OF IMPELLER				HAND-PUSH	SELF-PROPELLED	FWD. GEARS	REV. GEARS	ENGINE		
						Single Stage	Two Stage	Auger	Paddle					2-cycle	4-cycle	Elec.
MASSEY FERGUSON	MF 20S	$225	4	148	20	√		√			√	1	0		√	
MONO	S-422	$190	4	165	22	√		√			√	1	1		√	
MONTGOMERY WARD	GARDEN MARX 481	$80	3	83	18	√		√		√		0	0		√	
	GARDEN MARX 484	$190	4	215	22	√		√			√	1	1		√	
	GARDEN MARX 486	$240	6	230	26	√		√			√	1	1		√	
	GARDEN MARX 477	$290	6	310	26		√	√			√	2	1		√	
	GARDEN MARX 478	$340	6	315	26		√	√			√	2	1		√	
PIONEER GEN-E-MOTOR	SM-64	$222	4	135	20	√		√			√	1	0		√	
POWER EQUIPMENT	183-B	$100	3	85	18	√		√		√		0	0		√	
	183-BSP	$150	3	100	18	√		√			√	1	0		√	
	204-BSP	$180	4	115	20	√		√			√	1	0		√	
	224-BSP	$200	4	125	22	√		√			√	1	0		√	
QUICK	65ST-3	$160	3	113	20	√		√			√	1	0		√	
	65ST-4	$200	4	154	20	√		√			√	1	1		√	
SEARS, ROEBUCK	131.8193	$80	3	26	14				√	√		0	0	√		
	131.8195	$85	1	26	14				√	√		0	0			√
	536.8216	$100	2.5	N.A.	15	√		√		√		0	0		√	
	131.81926	$165	3.5	N.A.	20	√		√			√	1	0		√	
	536.8213	$175	3.5	N.A.	18	√					√	1	0		√	
	536.8222	$285	6	N.A.	24	√		√			√	2	1		√	
	536.8224	$370	6	N.A.	26		√	√			√	3	1		√	
SENSATION	DB-1	$80	3.5	39	14	√				√		0	0	√		
	SB-18	$190	4	100	18	√					√	1	0		√	
SIMPLICITY	4 H.P.	$245	4	210	23.5	√		√			√	1	1		√	
	6 H.P.	$315	6	244	26	√		√			√	2	2		√	
	7 H.P.	$365	7	274	26		√	√			√	2	1		√	
SUNBEAM	LCS	$75	1.4	N.A.	16	√		√		√		0	0			√
	LD-16	$100	1.4	N.A.	16	√		√		√		0	0			√
	SNE	$110	1.4	N.A.	16	√		√		√		0	0			√
	DSA	$120	1.4	N.A.	16	√		√		√		0	0			√
	DSL	$130	1.4	N.A.	16	√		√		√		0	0			√
	CD-16	$135	2.1	N.A.	16	√		√		√		0	0			√
	D-18	$135	1.4	N.A.	18	√		√		√		0	0			√
	DSL-18	$140	1.4	N.A.	18	√		√		√		0	0			√
	CD-18	$150	2.1	N.A.	18	√		√		√		0	0			√
	CDL-18	$160	2.1	N.A.	18	√		√		√		0	0			√
TORO	SNO PUP	$90	1.75	20	14	√			√	√		0	0	√		
	SNO PUP ELECTRIC	$110	2	20	14	√			√	√		0	0			√
	SNO PUP 21	$120	2.25	26	21	√			√	√		0	0	√		
	SNOW HOUND	$170	3	105	20	√		√			√	1	1		√	
WHEEL HORSE	REO ST-420	N.A.	4	140	20	√		√			√	1	1		√	
	REO ST-268	N.A.	6	260	26		√	√			√	2	2		√	
WISCONSIN MARINE	BOB-CAT 820	$285	4	235	20		√	√			√	1	1		√	
	BOB-CAT 1824	$350	7	280	24		√	√			√	1	1		√	
YARD MARVEL	YMS-400	$250	4	163	24		√	√			√	1	0		√	
	YMS-450	$268	4	177	24		√	√			√	1	0		√	
	YMS-575	$290	6	180	24		√	√			√	1	0		√	

Note: Chart contains information on self-contained units only. No tractor attachments are included. N.A.—not available.

best for you, look for features like these (not all apply to all types of machines).

- Winterized engines. Most modern engines are covered to keep out snow, or use exhaust heat to stay dry.
- Big controls, easy to use with mittens.
- Enclosed gears and chains for safety.
- A device to protect the machine if you hit an object beneath the snow. Slip clutches are best. Shear pins work as well but are a nuisance to replace.
- Electric start. A real help in starting a big machine with cold oil in the crank. PS

Snow-thrower attachment makes garden tractor an all-seasons tool. This Gravely is a heavy-duty machine. The 26" two-stage attachment throws snow up to 50'. A 34" attachment is also available.

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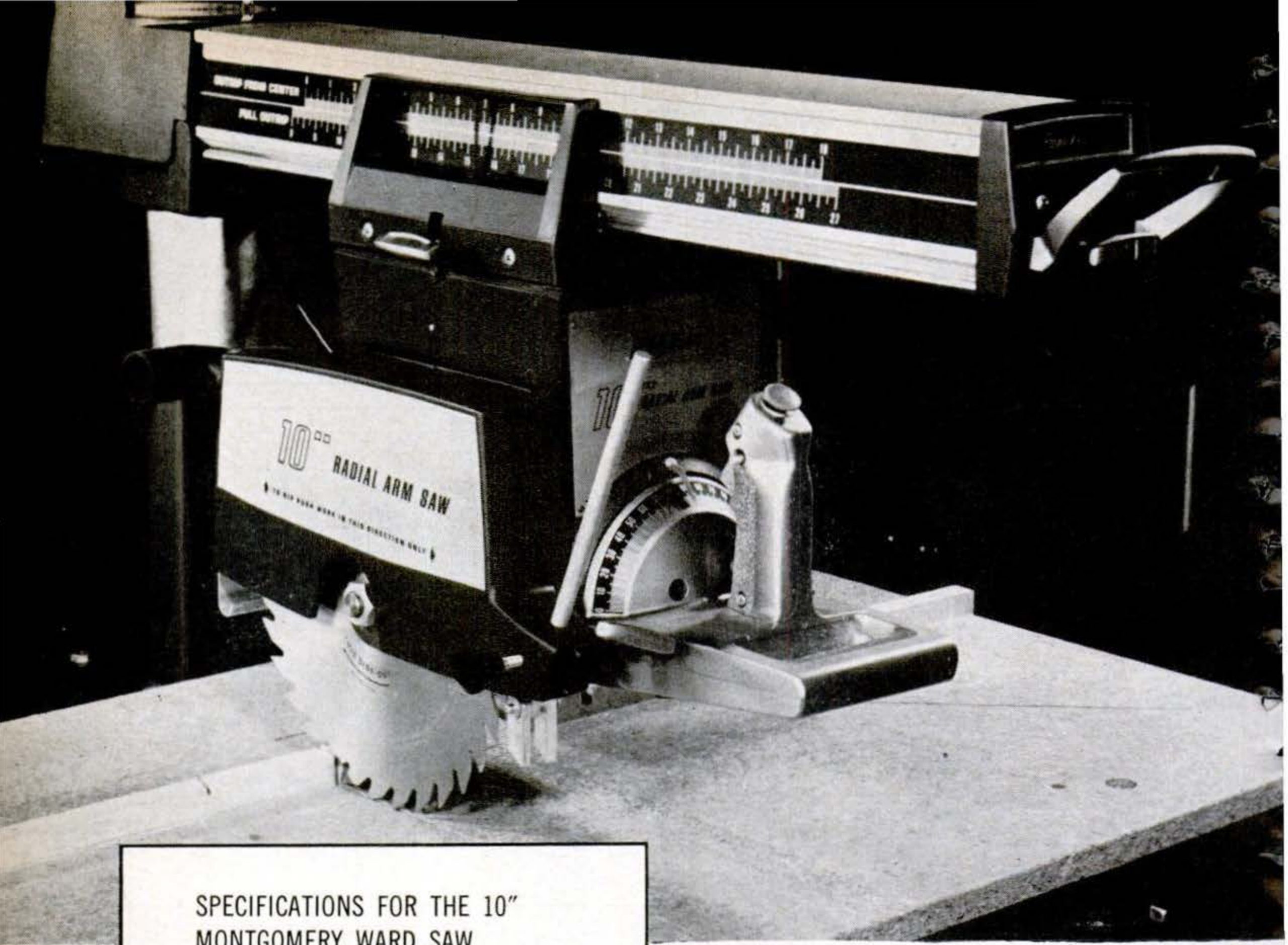
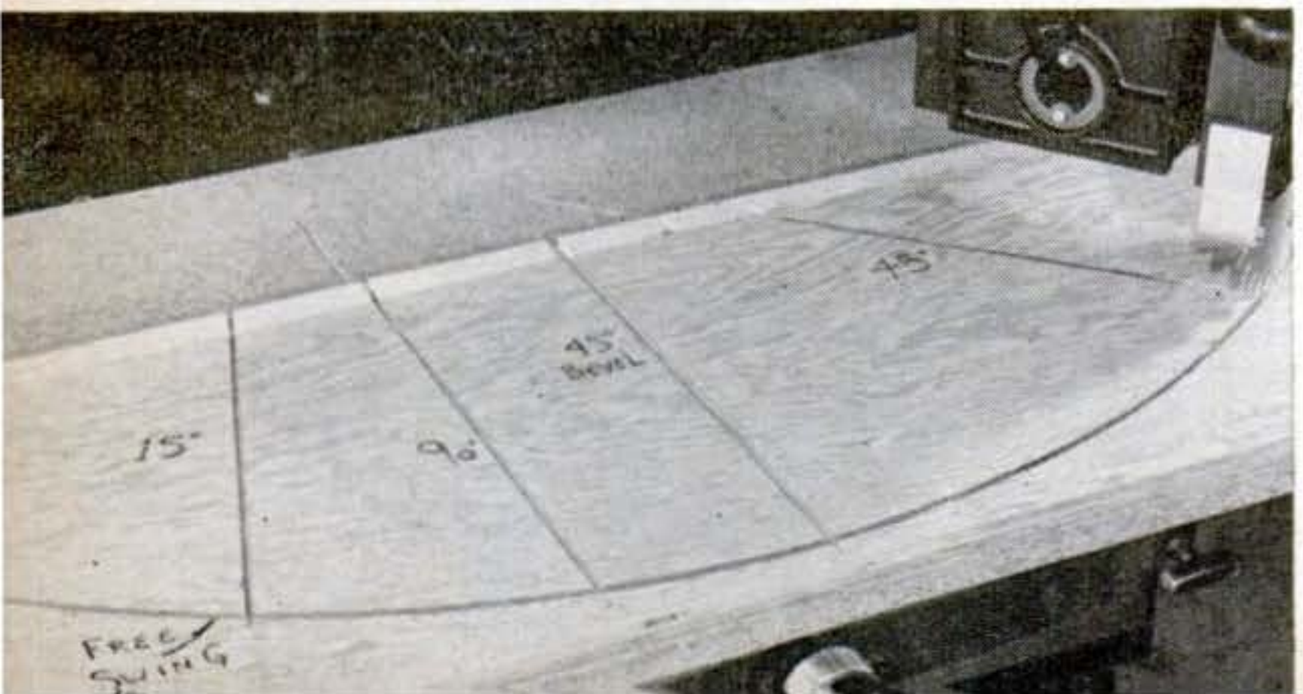


SPECIFICATIONS FOR THE 10" MONTGOMERY WARD SAW

Motor: 2 hp. at 3,450 r.p.m., ball bearing, high- and low-speed spindles, 115 volts
Table: ¾" x 24" x 36"
Blade: 10" with ⅝" hole
Depth of cut: 3 11/16"
Depth of 45-deg. cut: 2⅛"
Width of rip: 26¾"
Width of crosscut (in 1" stock): 17¼"
Miter index stops: fixed stops at 0 deg. and 45 deg. left and right
Bevel index: fixed stops at 0 deg., 45 deg., and 90 deg.
Blade-stop time (free running): under 10 seconds

Test board checked out the consistency of auto-stops on the Ward saw and the degree of care you must use in making manual settings. Results for all stops were topnotch, as the photograph shows.



PERSONAL-USE REPORT:

Two Handsome New Radial-Arm Saws

Both have three points in common: safety and convenience of front controls, power, and eye appeal

By R. J. De CRISTOFORO

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There has been a trend over the past couple of decades toward styling power tools as if they were "home appliances" for men—to give them the same kind of visual appeal that sells washing machines and dryers. Sometimes this leads to superfluous gingerbread. But not with these two newborns. They are a combination of brains, brawn, and looks.

I tested both saws for power, convenience, and accuracy. I made my accuracy check with the test boards shown here.

I clamped a board to the table of each saw and adjusted the blade to cut into the board about ⅛". I made cuts at various settings where auto-stops are provided and at a few in-between places, then removed the board. After using the saw a few days in a variety of workshop applications, I remounted the test board in its original position and repeated the test cuts. Any variation in kerf width would quickly indicate inconsistency.

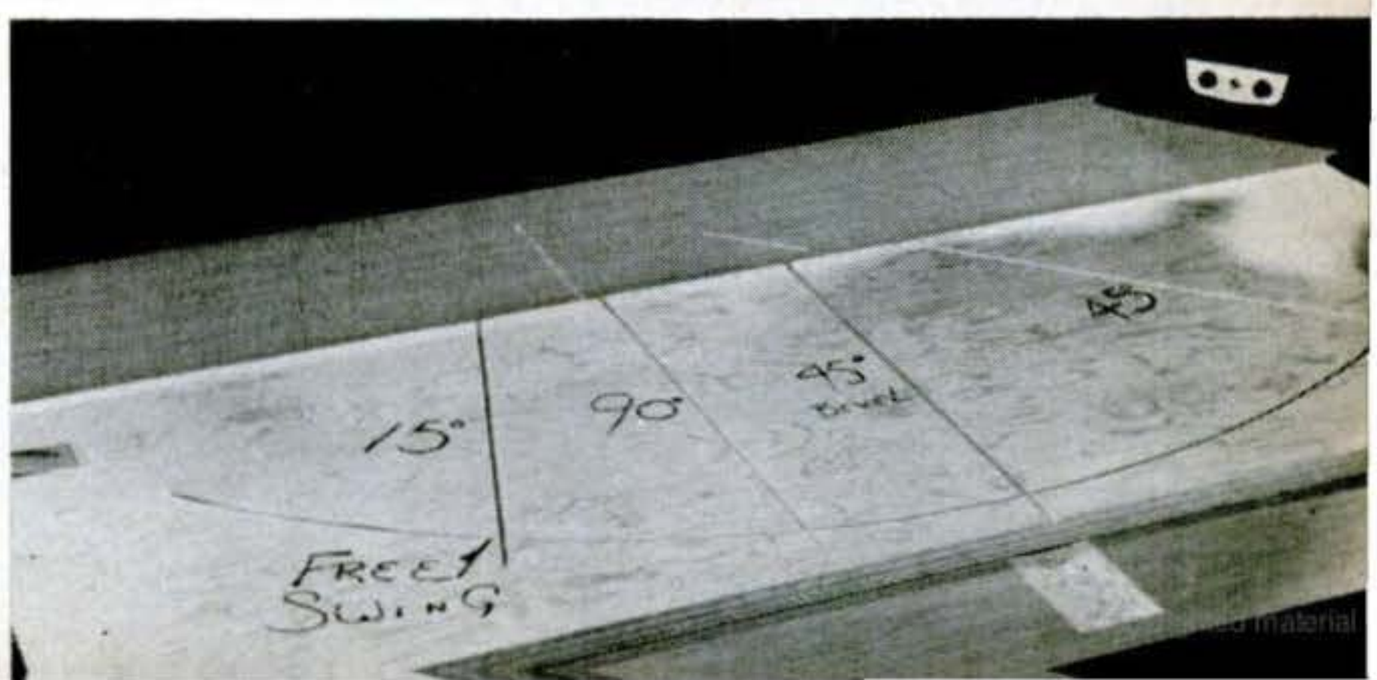
Let's take a look at each saw, and see how they checked out in power, convenience, and accuracy.

Continued

SPECIFICATIONS FOR THE 12" SEARS, ROEBUCK SAW

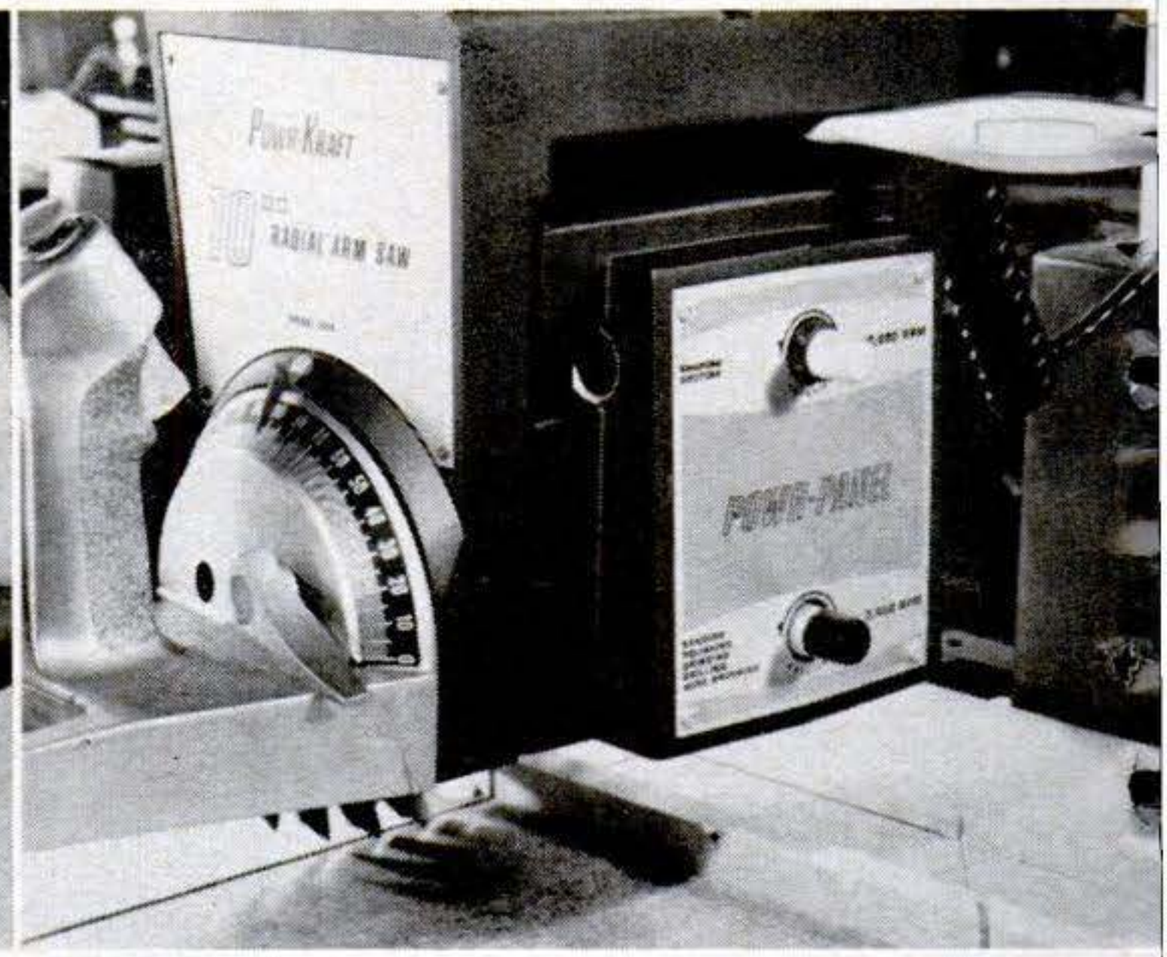
Motor: 3 hp. at 3,450 r.p.m., capacitor start, ball bearing, 120 or 240 volts
Table: 1" x 28¼" x 44"
Blade: 12" with ⅝" hole
Depth of cut: 4 1/16"
Depth of 45-deg. cut: 3⅛"
Width of rip: 26½"
Width of crosscut (in 1" stock): 14¾"
Miter index stops: arm rotates 360 deg., fixed stops at 0 deg. and 45 deg. left and right
Bevel index: fixed stops at 0 deg., 45 deg., 90 deg.
Blade-stop time (free running): under 20 seconds

Results of the accuracy-board test with the Sears saw were excellent. All actions were smooth—locks were positive and crisp. It's a good idea to use a test board to check out a saw periodically.

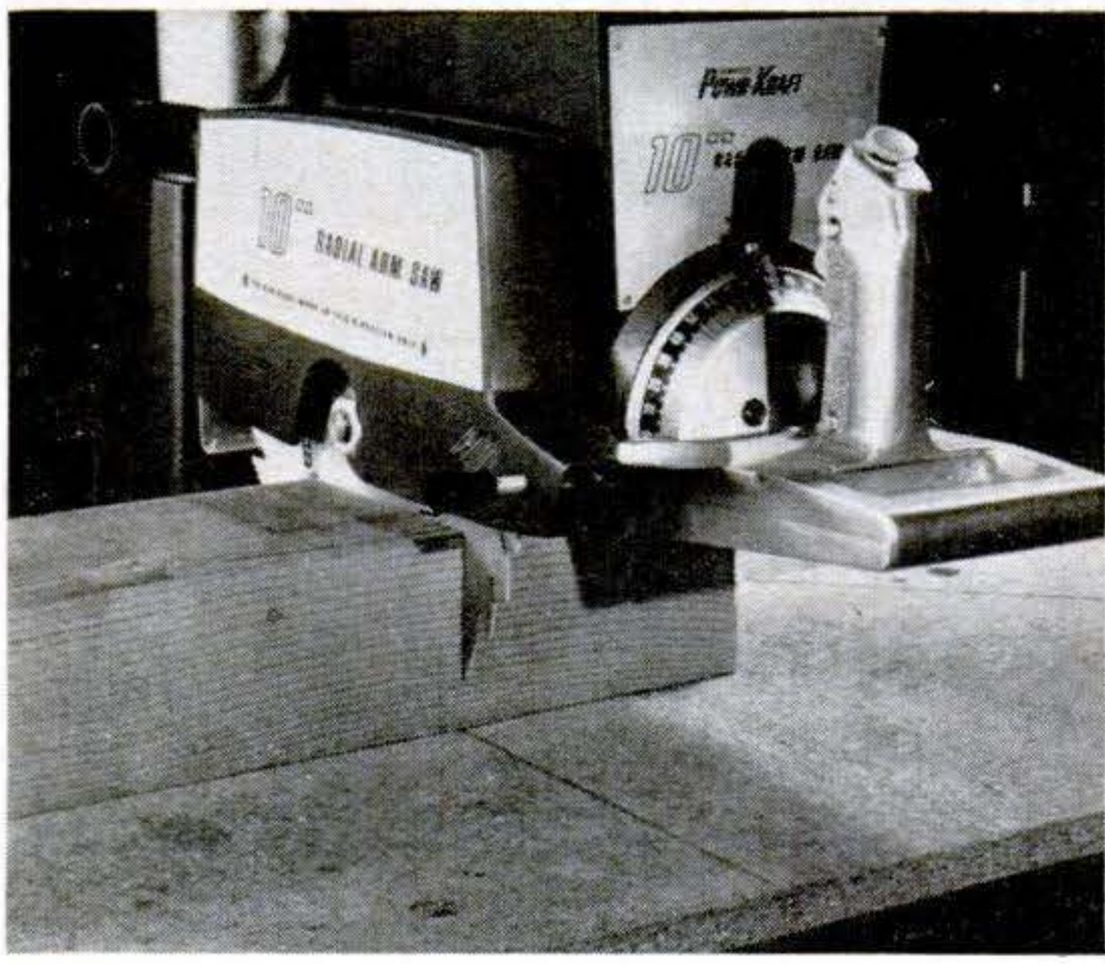


Two auxiliary spindles—one that turns 20,000 r.p.m. an

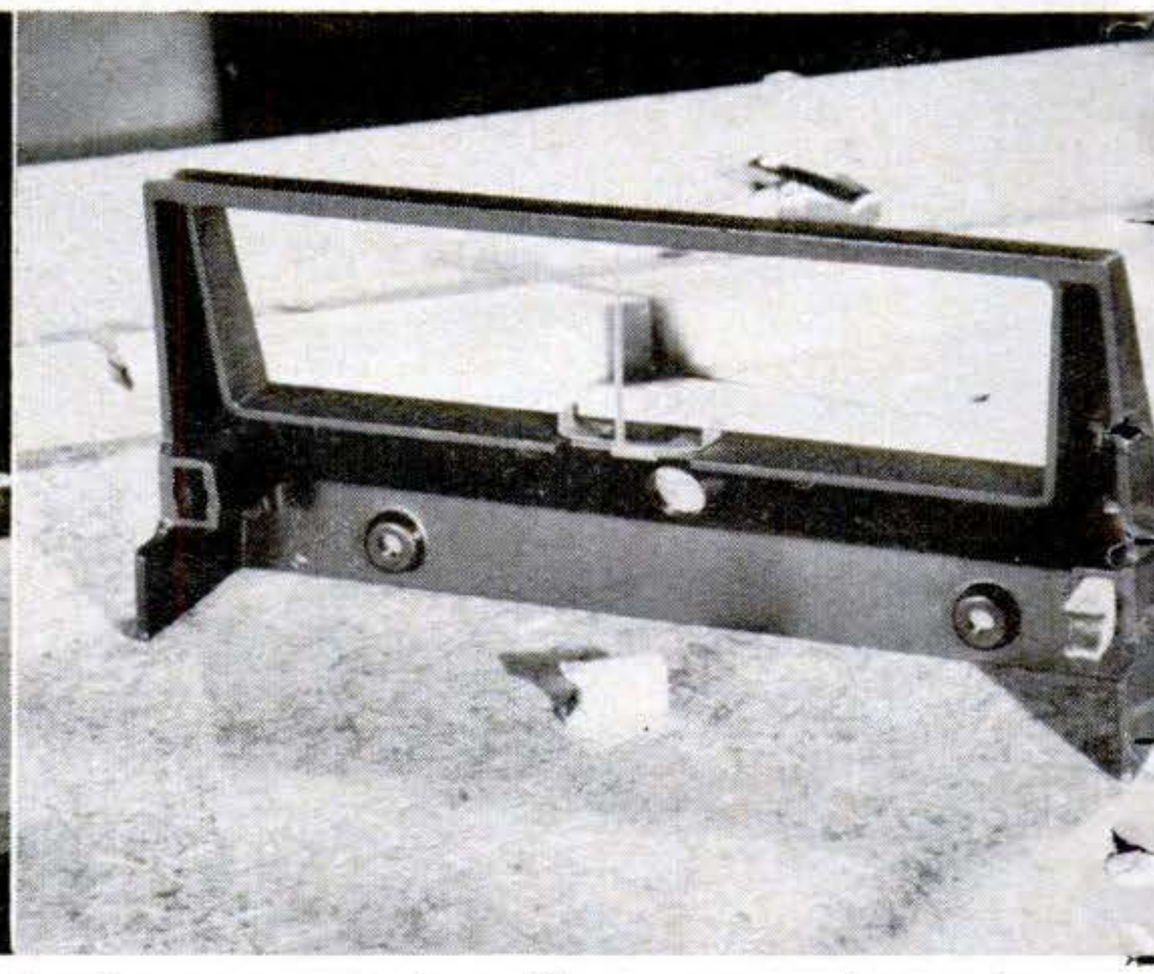
All power controls are in the pistol grip. Press the thumb button; then squeeze trigger. Plunger locks saw on; remove thumb button to lock saw off.



The Powr-Panel has two auxiliary spindles. One runs at 20,000 r.p.m. for high-speed attachments, one at 3,450 r.p.m. for grinding, polishing, etc.



Maximum depth of cut with clearance under the motor is $3\frac{11}{16}$". An end-squaring cut lets you go to $3\frac{7}{8}$", but you'll have to remove the blade guard.



Carriage cover attaches with two screws. It contains twin spring-loaded wipers of felt to clean dust off the tracks each time you make a cut.

When you receive one of these beauties in its shipping container, you wonder how Montgomery Ward ever put so much in such a small package. It *is* masterful packaging. You'll have to spend about two hours setting the saw up.

To my mind, the indoctrination you get from setting it up is all to the good. Any power tool should be checked out for accuracy before being used. Much can jiggle out of adjustment between the final assembly at the factory and that first cut in the workshop.

Except for the rip lock, which must of necessity travel with the carriage, all controls are frontal. This includes two clamp devices that lock the table boards together, an extremely practical innovation.

The elevating crank works with precise smoothness, but there is a possibility that, I think, the instructions could profitably mention. If the knob on the crank should happen to be positioned higher than the table surface, there might be interference with the work. The ¼" clearance called for between table and bed is not sufficient to eliminate this possibility.

The good-looking pistol-grip handle that

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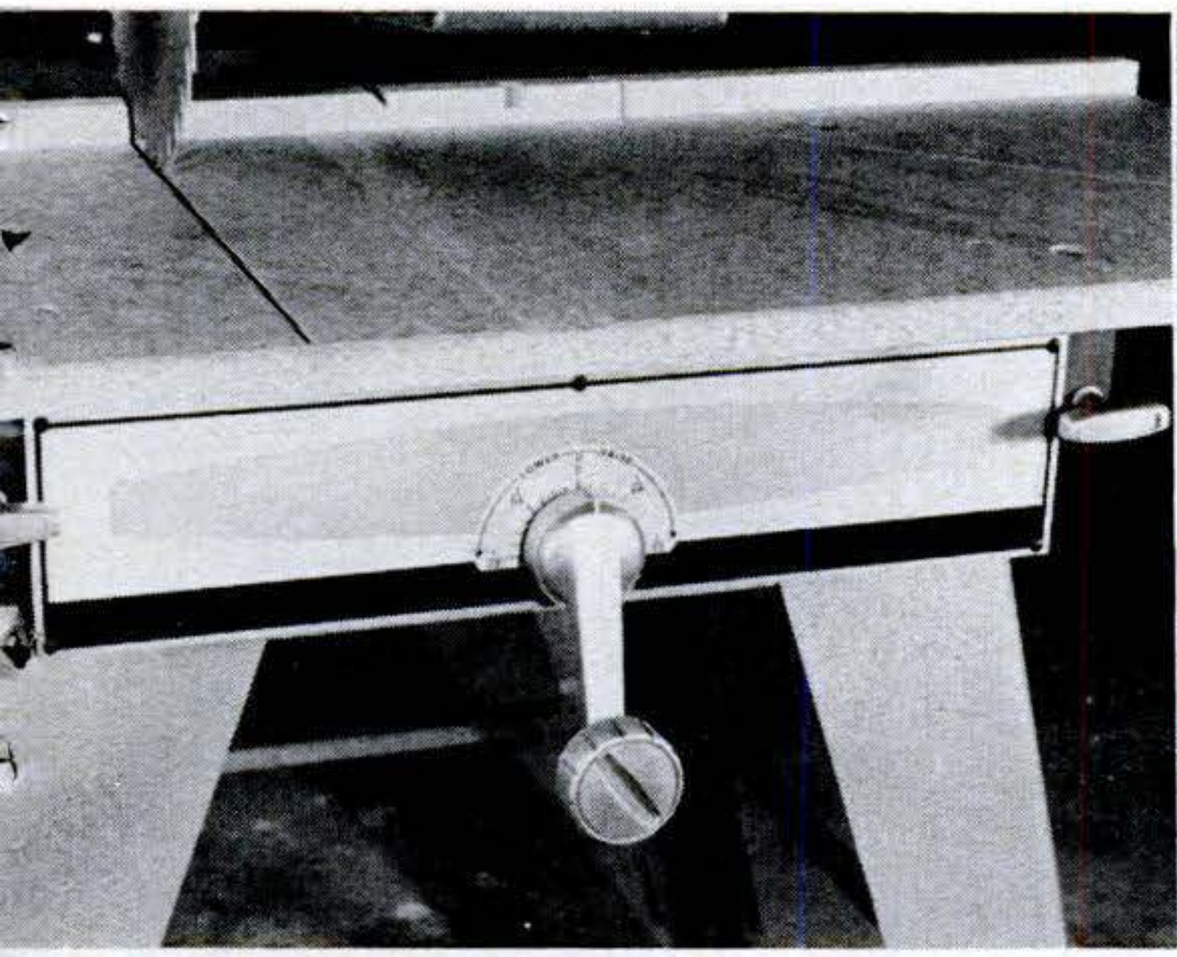
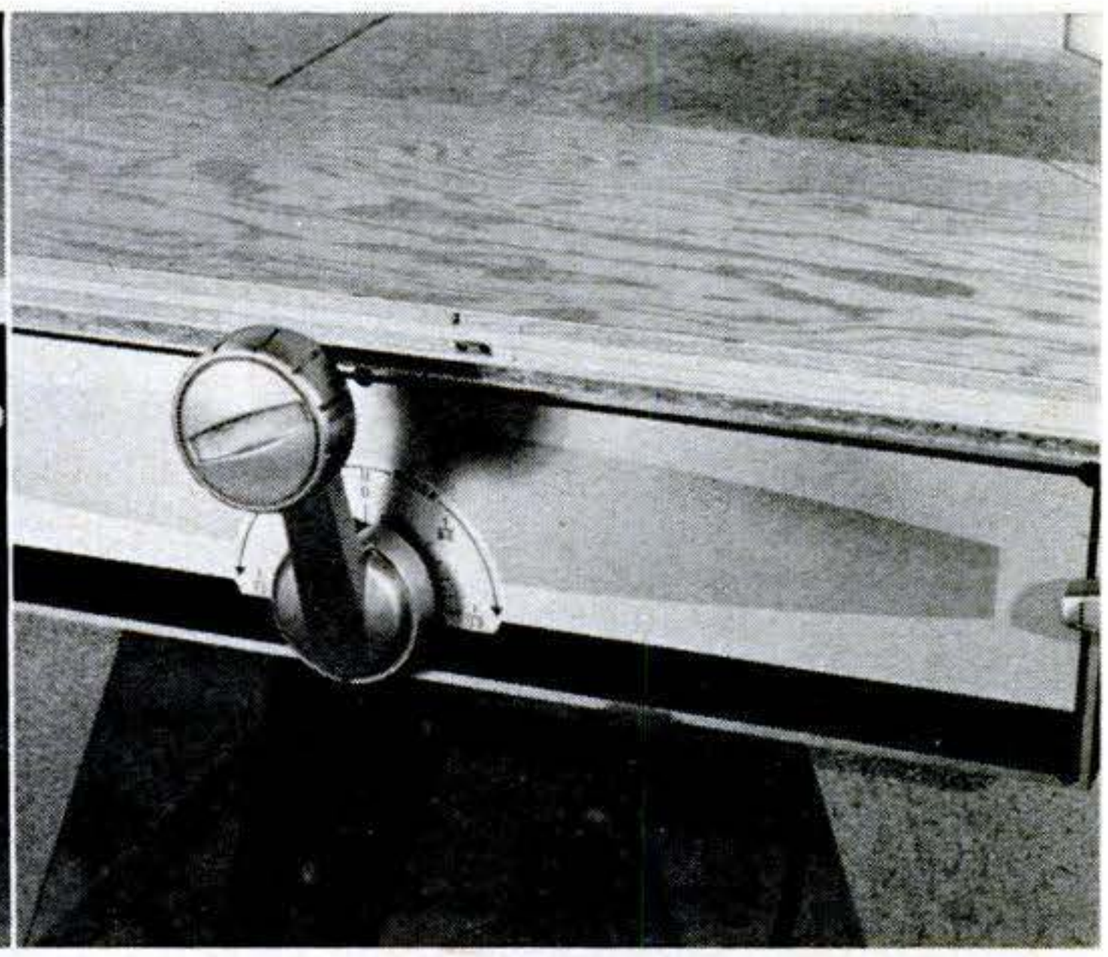
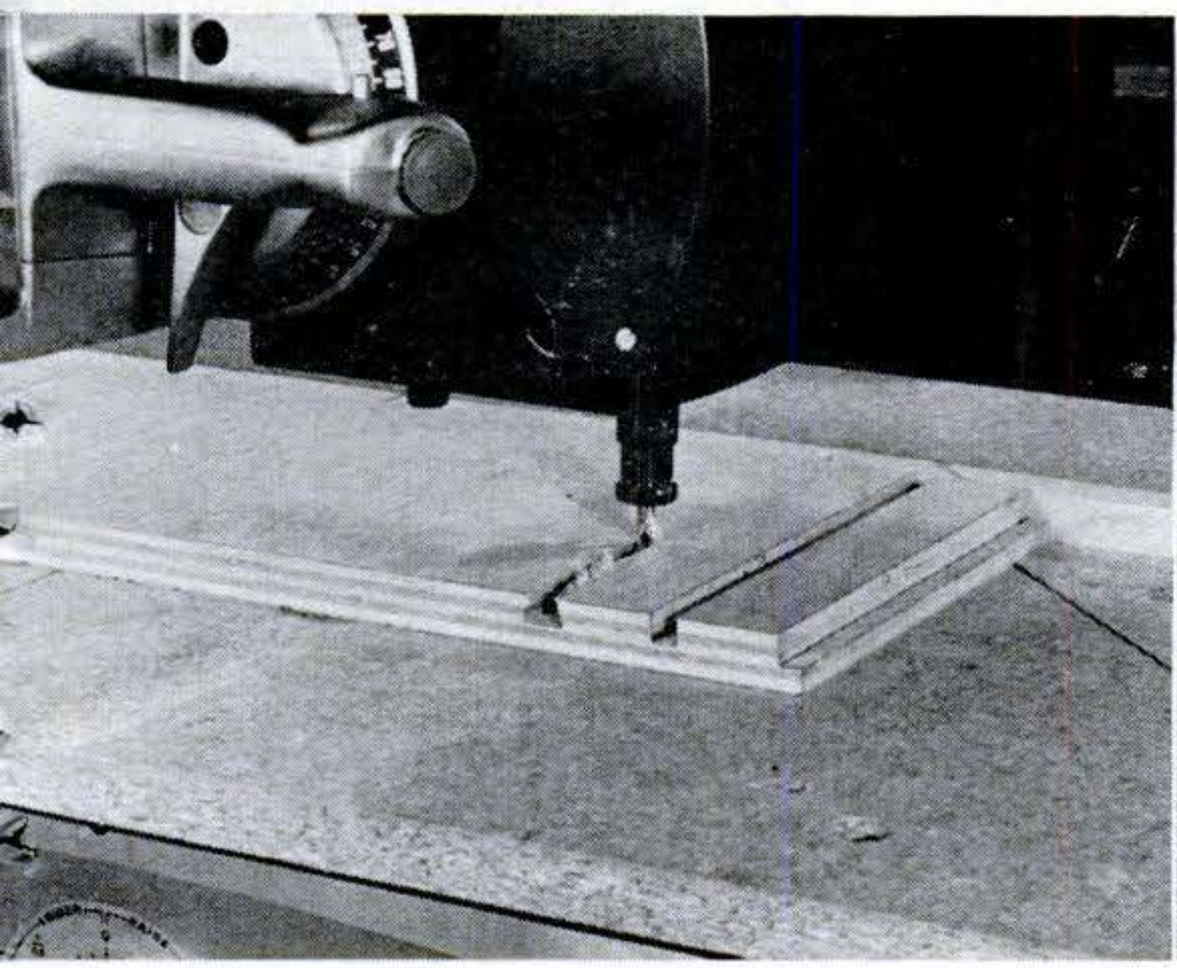
ne that turns 3,450—make Ward's saw an all-around tool



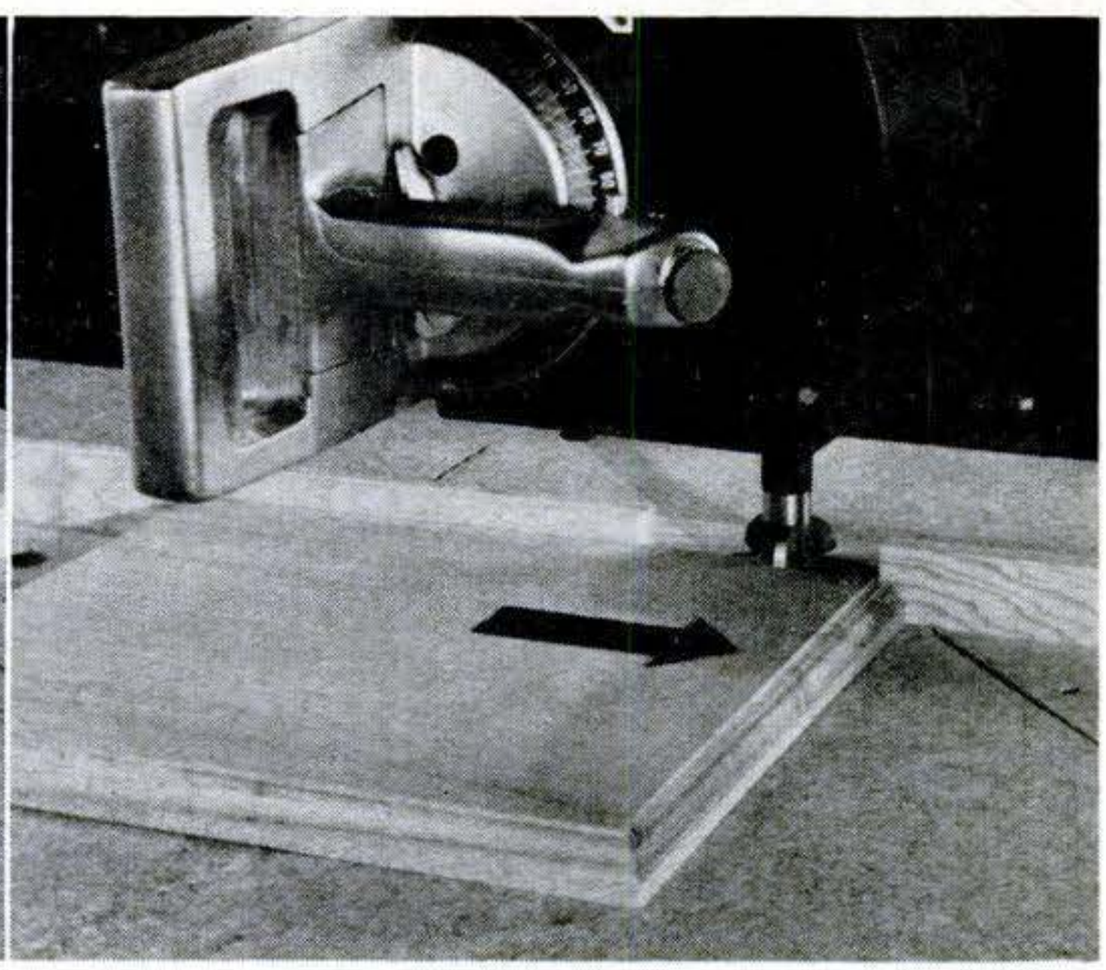
Graduations are marked for fine up and down adjustments, but you should consider play in crank. Handles at left and right control table-board clamps.



Initial table-height position should be set with elevation crank as shown. Otherwise, crank might interfere with the work under certain circumstances.



High-speed shaft lets you rout clean dovetails, other shaped grooves. At 20,000 r.p.m. you're assured of superb cuts unless work is fed too fast.



Shaping is also done on high-speed spindle. A special L-shaped fence is required, but you can make one in minutes. Arrow indicates direction of feed.

you grasp to move the carriage contains an on-off trigger, a plunger for continuous "on" operation, and a plastic key-button. You must depress that key-button before you can activate the trigger. These controls are really convenient for one-hand operation. And preventing unauthorized use of the machine is simple—you just remove the plastic button.

What about accuracy? For accurate cuts, a radial-arm saw must adjust precisely. It must also return to preset stops. I checked for these things by means of the test board. The saw checked out great—with some variation on the manual settings. But this merely proves the need for extra care where human error is a factor.

How much power? There's plenty of it—two horsepower that you can accept literally and prove out in practical fashion. If you work with sharp tools, as you should, and always feed to avoid choking the cutting tool, there is more muscle here than you are ever likely to need. Stall it? I won't take bets that you can't, but it would have to be a deliberate attempt or an offbeat procedure.

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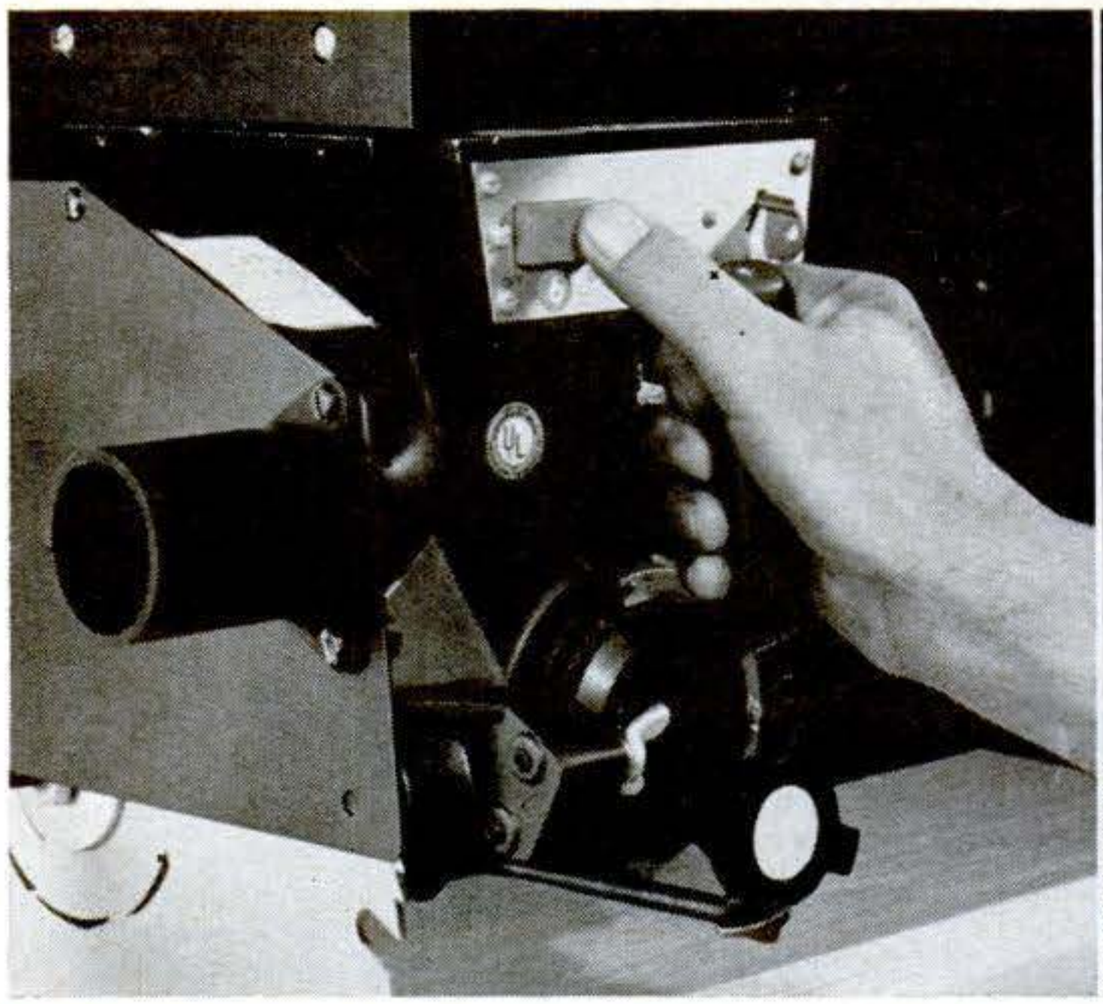
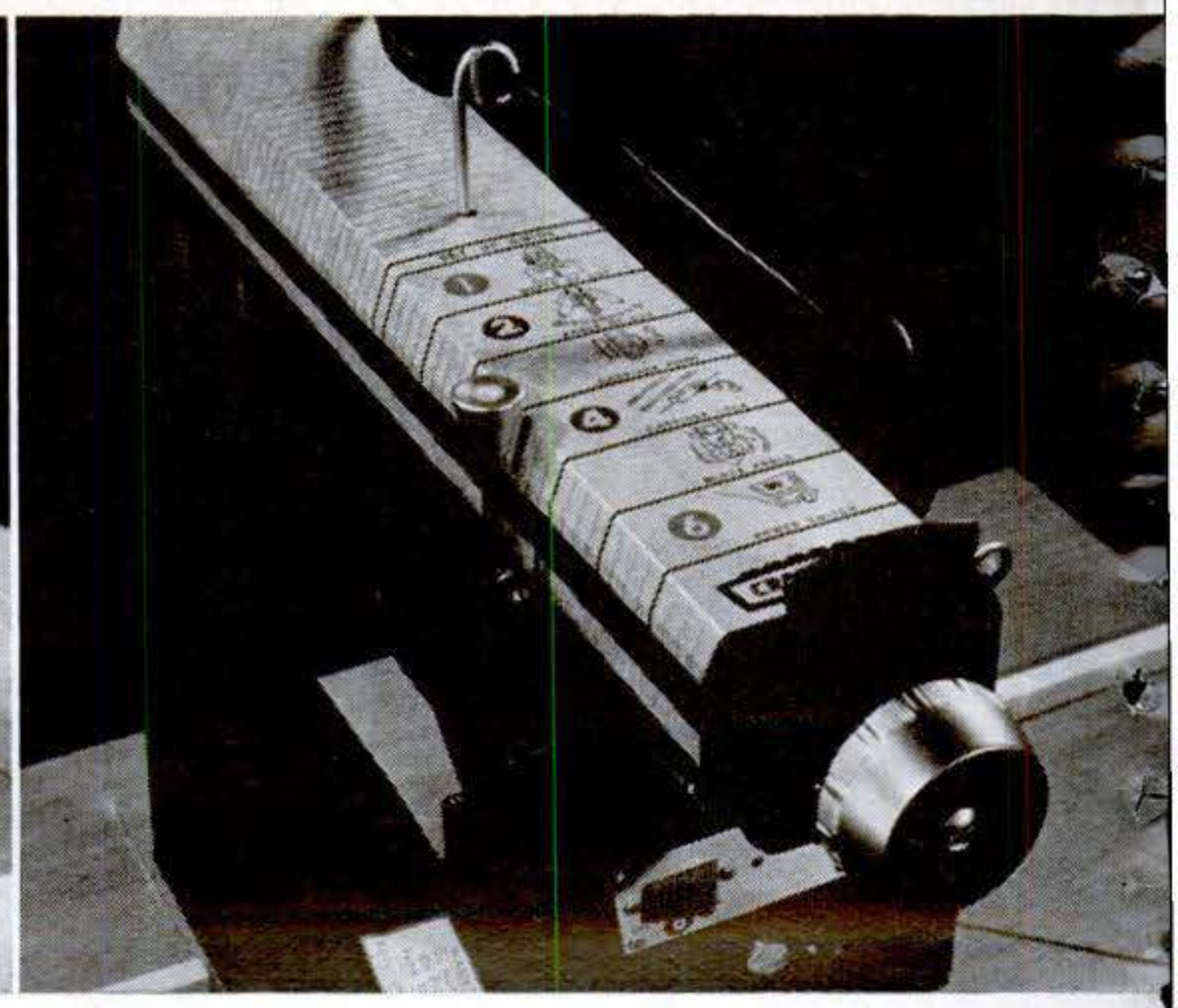
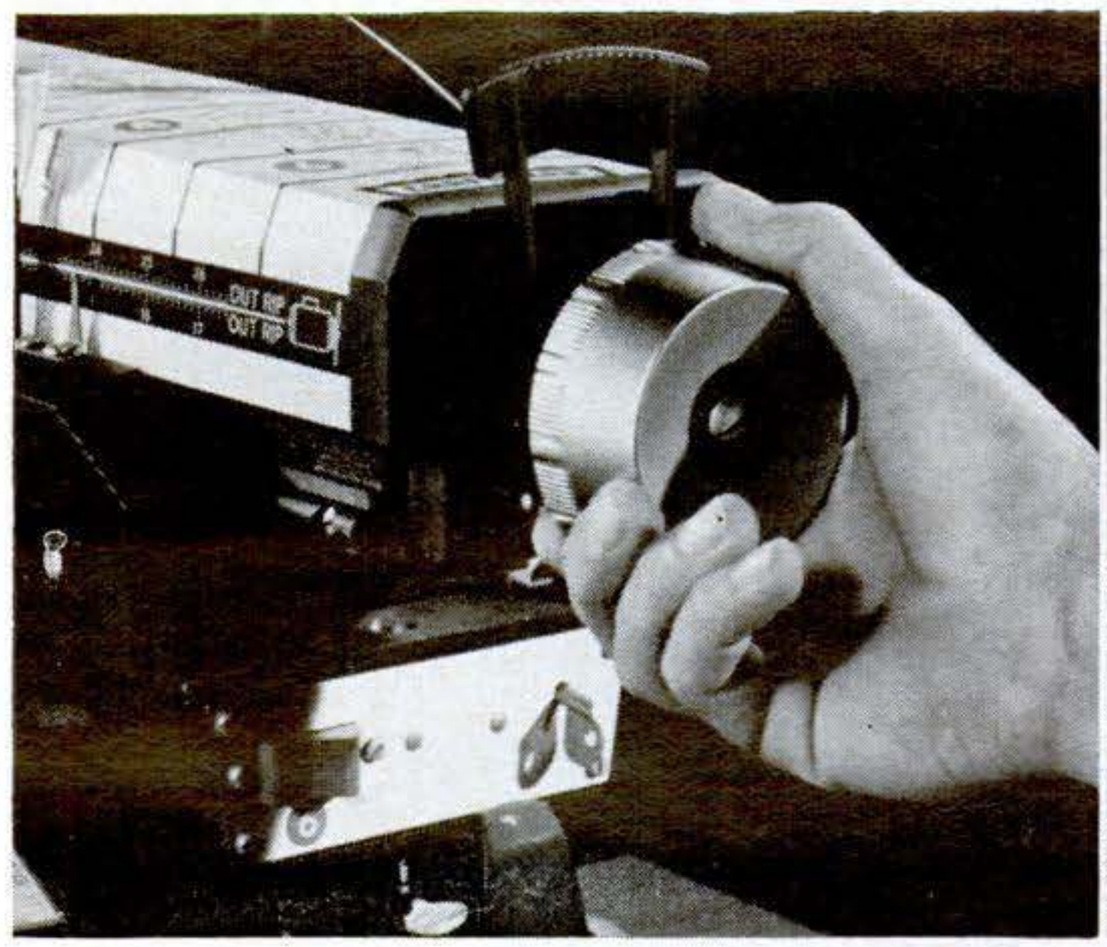
The new Sears 12" radial-arm saw has a whopping depth of cu



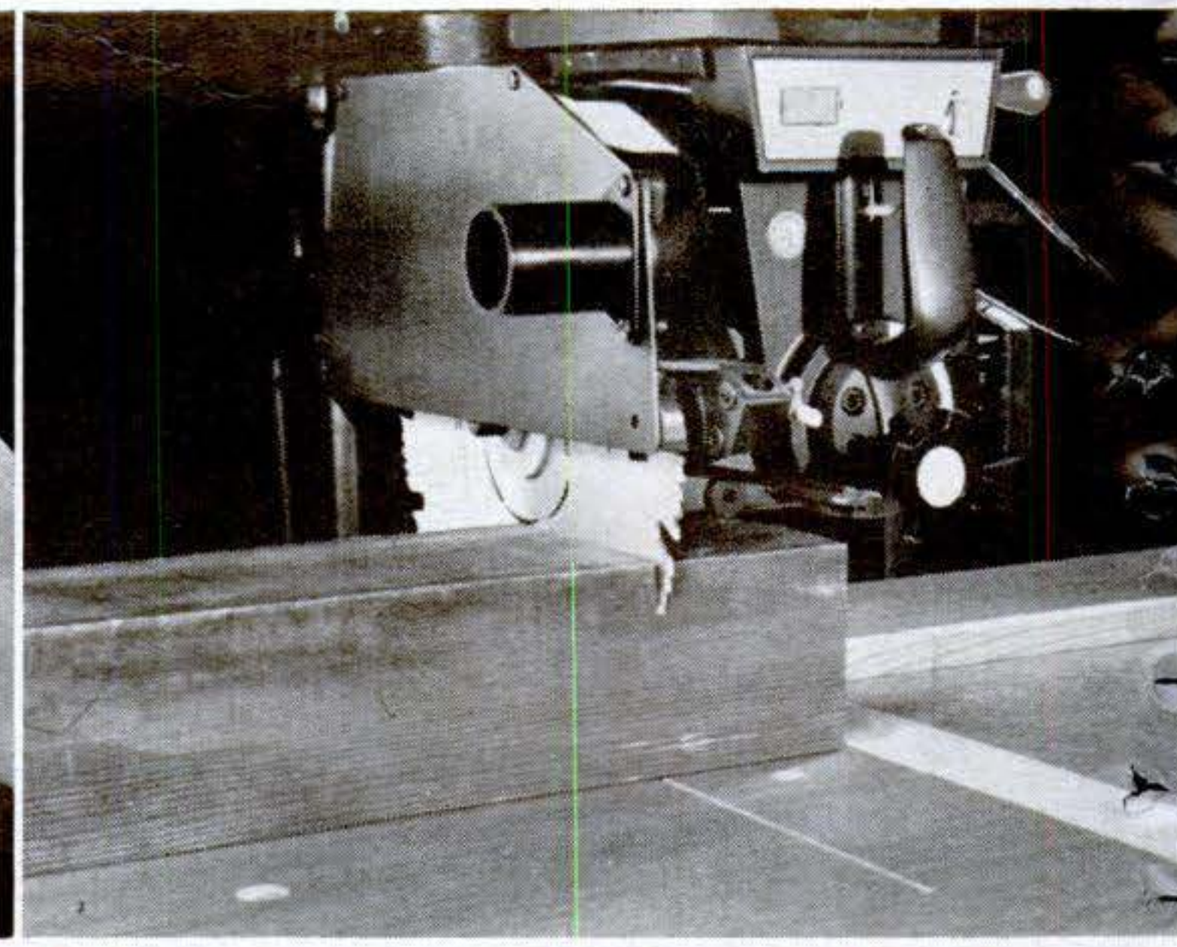
Comfortable handgrip is used to move carriage. The on-off switch is close enough to reach easily with the thumb. Remove key at right to lock saw off.



Instruction chart is printed on the top of the arm, making it easy for beginners to find important areas. Controls are numbered, correspond with chart.



Large knob locks the arm in any position. Preset stops are provided at 0 and 45 degrees left and right. You pull handle at top to release stops.



Depth of cut with clearance under motor is 4"–4¾" on an end cut. Powerful three-hp. motor and sharp heavy-gauge blade make cuts like this easy.

A 12" heavy-gauge blade driven by a three horsepower motor! If this is a scheme by Sears, Roebuck to attract the contractors and big-projects men as well as home workshoppers, the results indicate crafty foresight.

The tool takes a couple of hours to set up, including attaching rugged, steel legs. It comes wired for 120 volts, but you may decide right off to go the 240 route—instructions for changing a few motor wires are right there. I tried it both ways, with no complaints. But with a three-horse motor, especially under continuous heavy-duty use, the 240 idea is a good one.

Controls are frontal except for conventional rear placement of the table-board clamps and, of course, the side position of the carriage lock. The table clamps—long thumbscrews—pass through short, grooved posts that slip into keyhole slots in the bed. I found this a little inconvenient since there is enough play here for the back edge of the table boards to rise when the clamps are tightened. Avoid this by holding the board down as you take up on the clamps.

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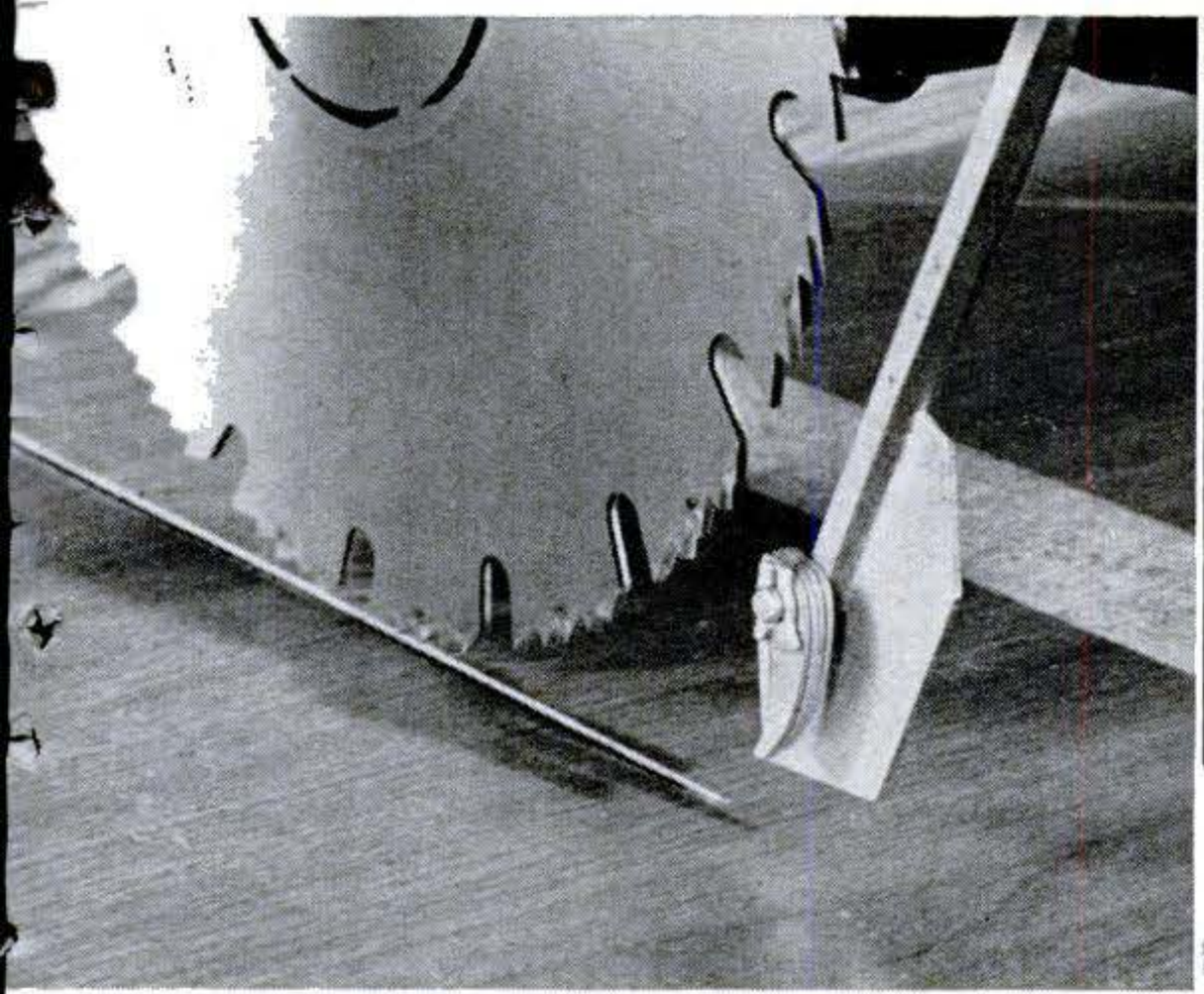
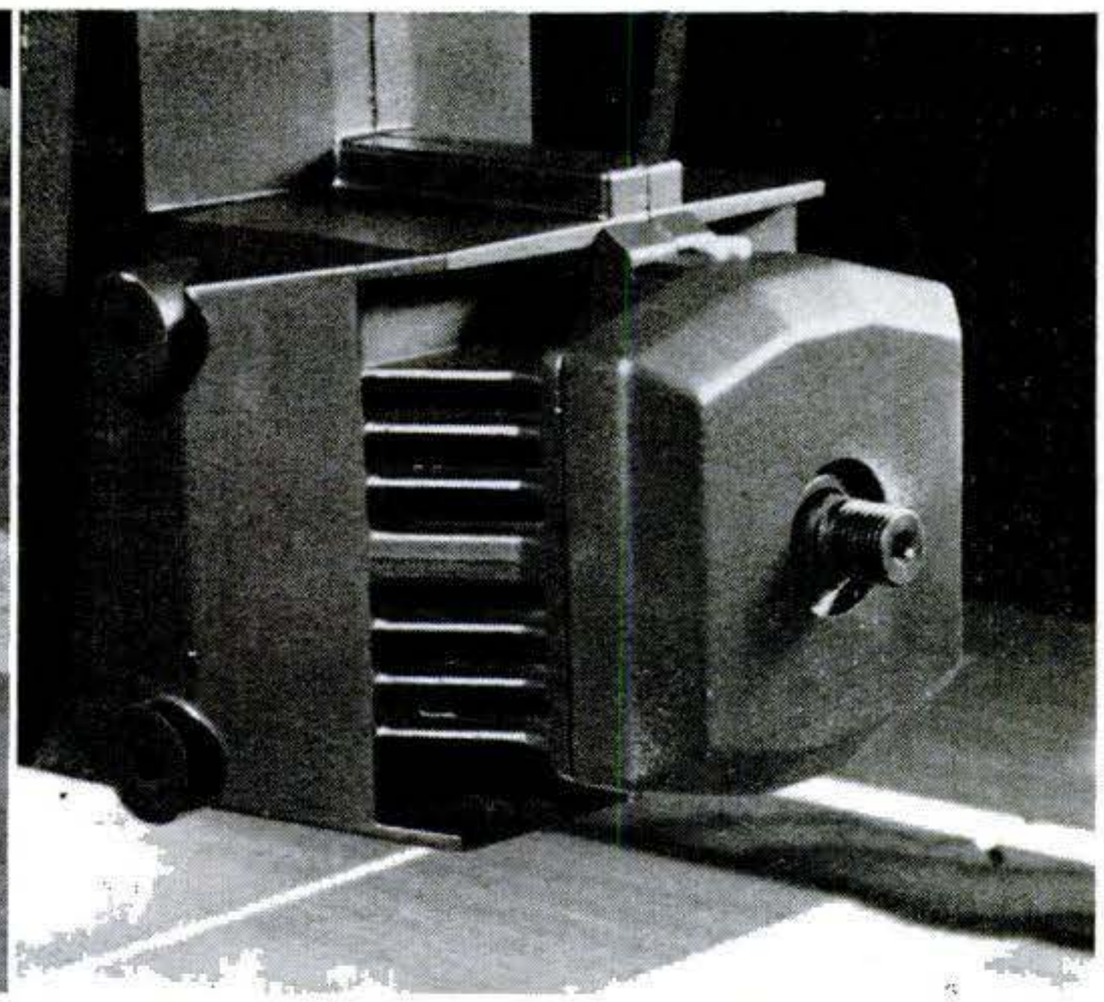
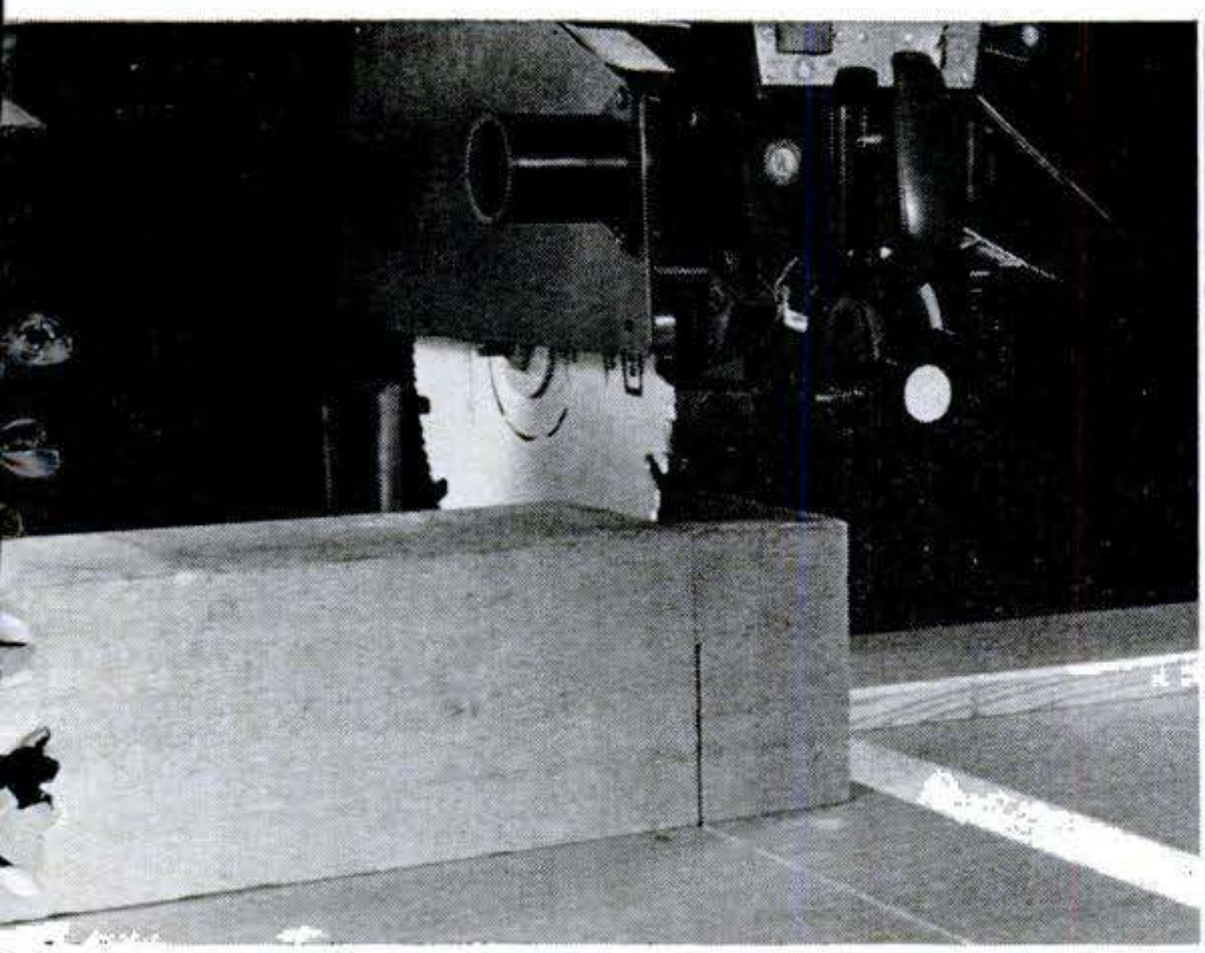
and plenty of power to handle any job you have to do



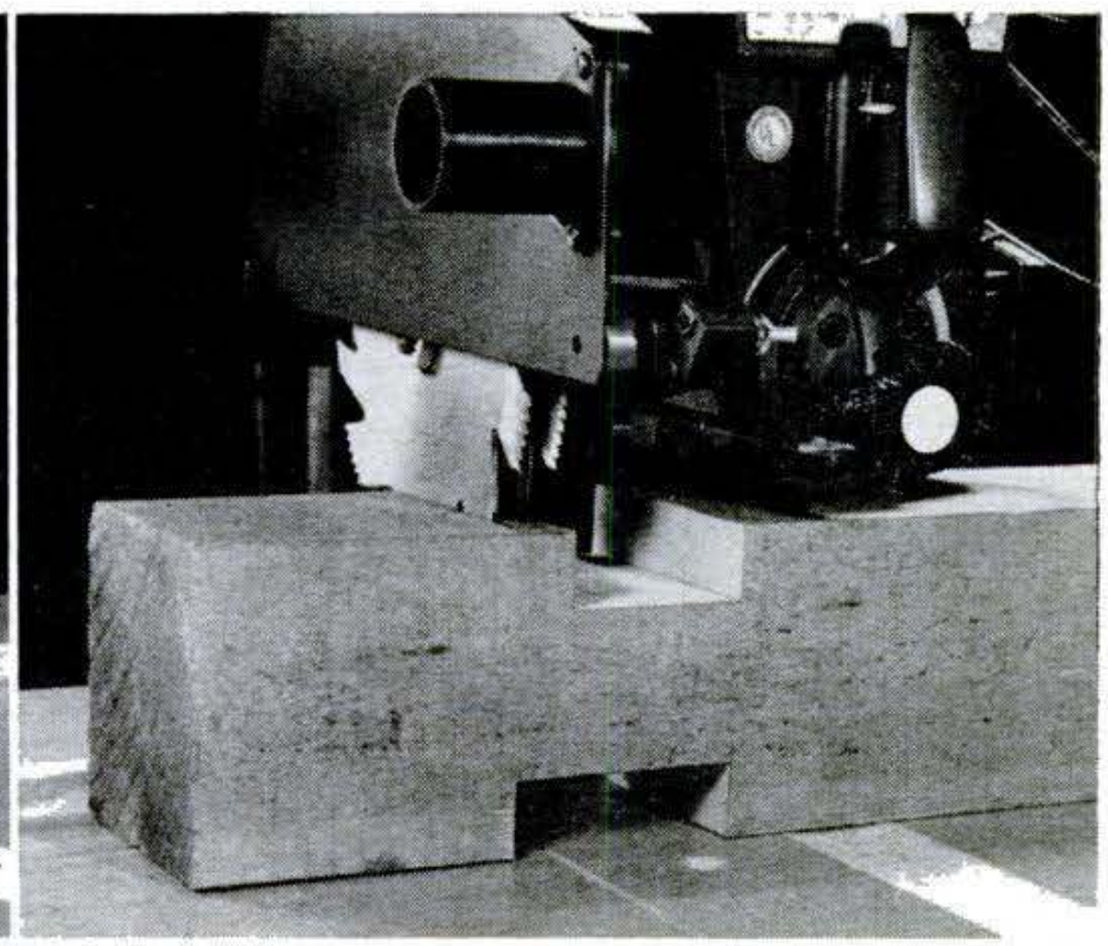
An innovation on anti-kickback post is a splitter designed to keep kerf open on rip cuts. It's a nice idea, but something of a nuisance to adjust.



Outboard spindle with ½"-20 thread takes accessory key chucks for router and dovetail bits. The 3,450-r.p.m. speed is too slow—requires slow feed.



A two-pass slice through a six-by-six is no chore. If you ever use a lighter blade on a saw like this, be sure to stabilize it with large washers.



Saw turns an 8" dado assembly with ease, no vibration. Three-hp. motor behind sharp blade makes for easy cutting, is almost impossible to stall.

Action of the elevation crank is silk-smooth throughout its range, and the carriage glides like sharp skates on ice. The on-off switch is close to the handle you grip to move the carriage. Only a baby's hand would be too small to conveniently flick the switch while the handle was still gripped—and there's a key you remove when you don't want the tool used. A built-in electromechanical brake shortens coasting time after the motor is turned off.

Results with the accuracy test board were excellent. It's a good idea to make a test board of your own and use it every so often to keep your saw aligned. Any tool that's put through its paces should have an accuracy checkup periodically.

Calling the power of that three-horse motor ample is an understatement. I did things I'd never do during normal shop work, regardless of power: making cavernous dado and moulding-head cuts, putting excessive pressure against a sanding disk, and forcing rip cuts through tough stock. I won't take bets you *can't* stall it, but why do it deliberately? PS

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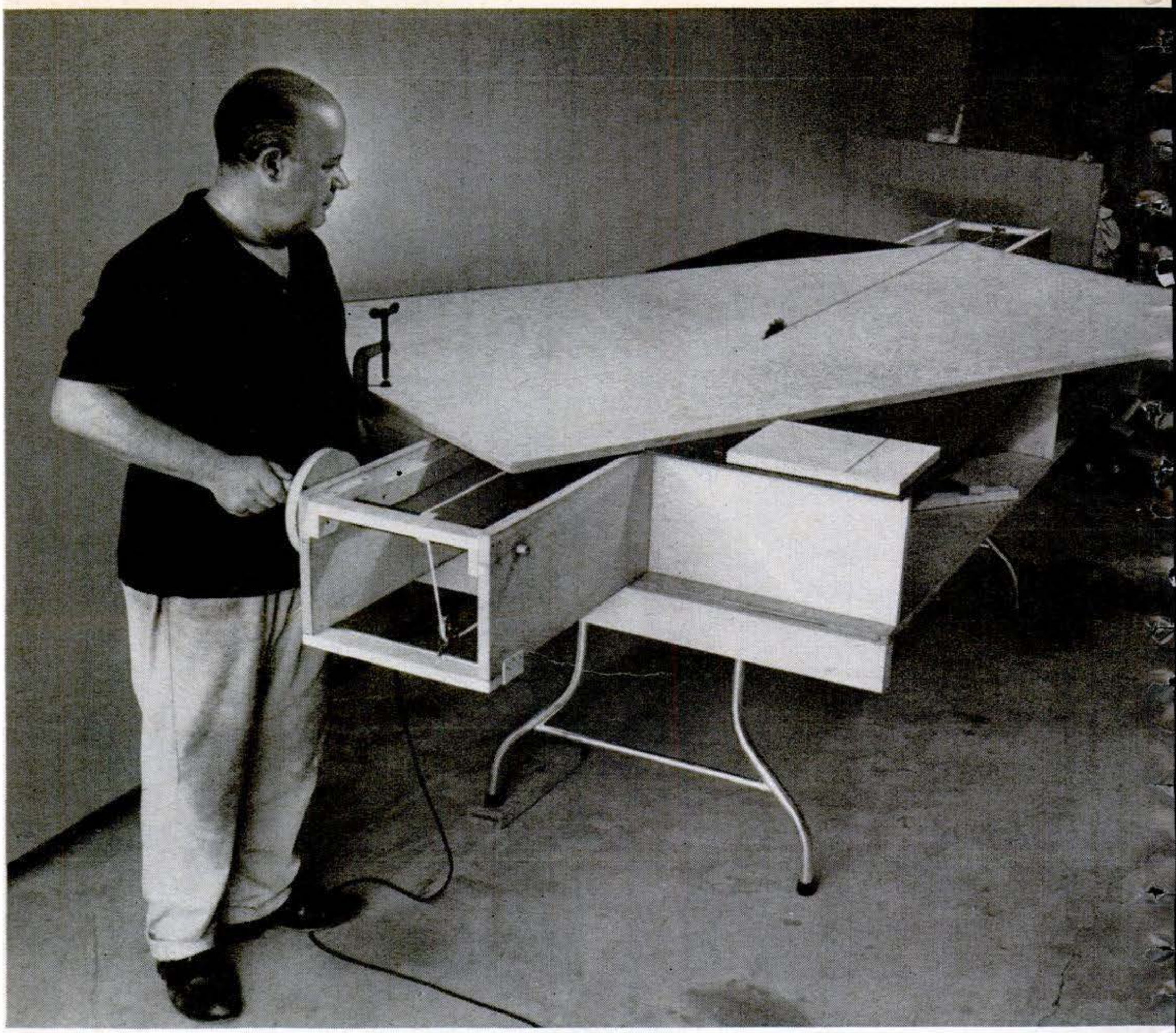

The Saw That Speeds

Make accurate cuts on big panels with a traveling, upside-down panel saw you can build yourself

By HERB PFISTER

Ever wrestle with an awkward, bulky four-by-eight sheet of plywood or hardboard trying to cut it up into accurately sized pieces? Or whack it up into roughly shaped pieces of manageable size, only to waste a lot of material making the finish cuts? Ever wish you could push back the shop walls to feed a big panel or long board in and out of your table saw?

This saw solves those problems. You can build it for under $65 worth of materials. It cuts a 9′-long kerf while you stand by and turn a crank that pulls the blade of a portable electric saw through the work—like the dorsal fin of a shark shearing the surface of the water.

You simply position the sheet on the table top, clamp it down, and crank away. It works on any odd-shaped panel, and you get your first cut right on the mark. When all the material is cut, the ample table top makes an excellent assembly bench. Four

Now! PS lies flat on your bench or table . .

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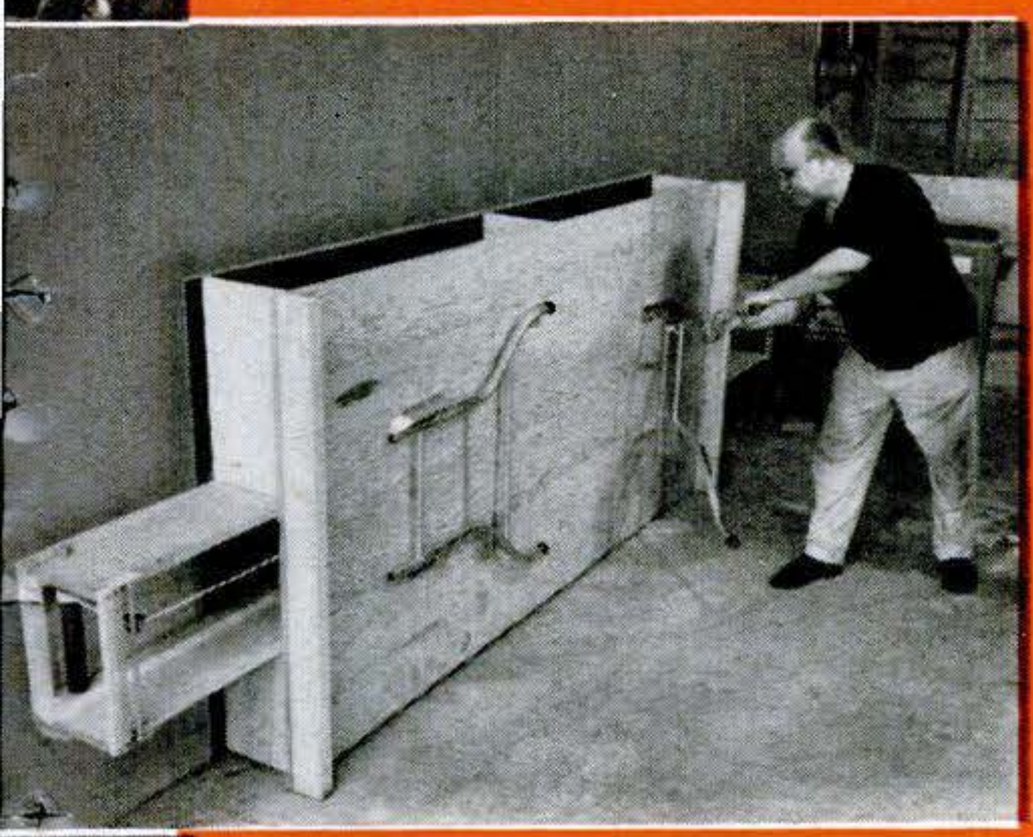
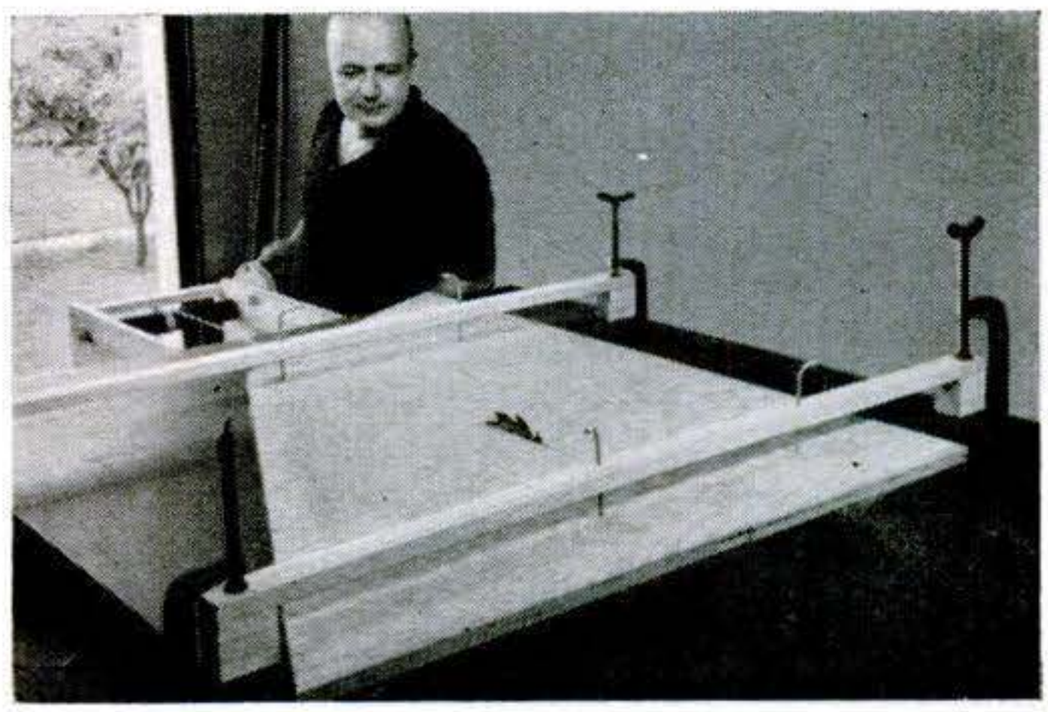
PS PROJECTS

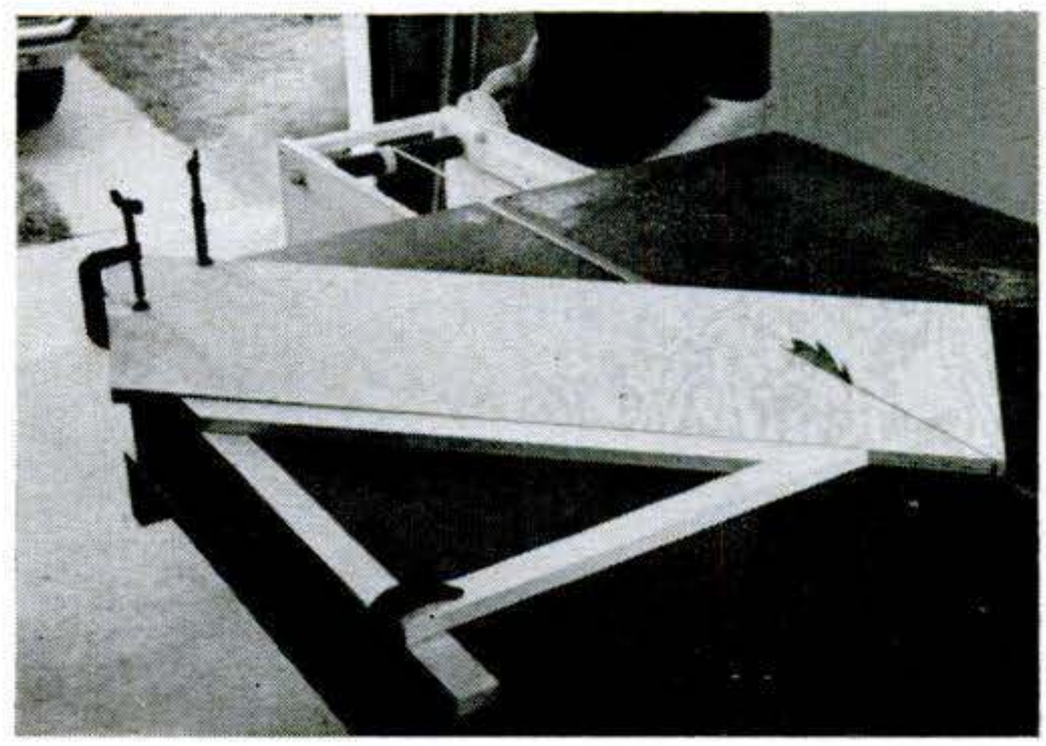
Cutting up big sheets of plywood and hardboard using a portable electric handsaw is easy with a panel saw like this one. Its 9′ cutting capacity will take a four-by-eight sheet diagonally, as shown at left. The saw folds up for compact storage against a wall (below) when it's not in use.



Here are some of the cuts you can make with this panel saw



Odd-shaped pieces can be clamped in any position for sawing. Bridge clamps, made as shown on a following page, are located to hold the stock.



Crosscuts and miter cuts on cumbersome pieces are made using a giant-size T square and angle gauge, made of one-by-two stock, clamped to the table edge.

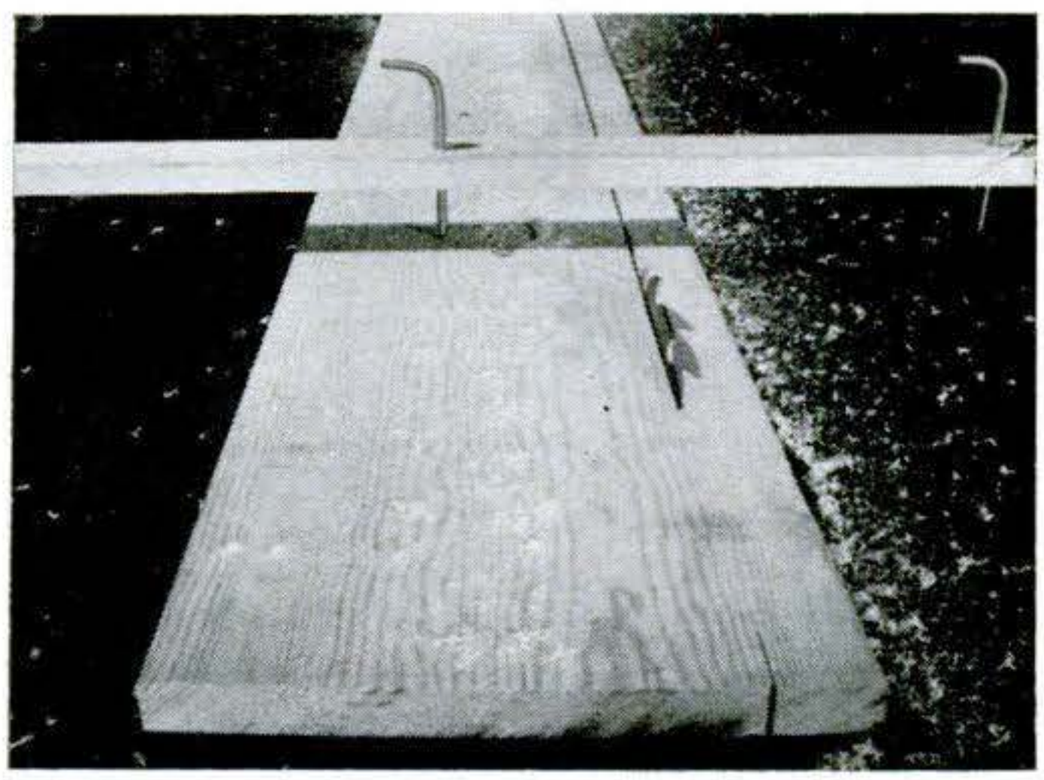
Your Plywood Projects

roomy compartments between the side braces give you storage for lumber scraps and tools. And this panel saw folds away in a 15″ space against a wall.

Accuracy assured. Simply align cutting marks made on edges of the work with the edge of a slot running down the center of the table—the table cut is made with the saw in its carriage. Two clamps secure the lumber against slipping while being cut, and the saw, mounted upside down beneath the table, moves along a track made slick by rubbing with paraffin wax. Flipping two sash locks releases the saw for portable use.

Simplicity of design and construction

[Text continued on page 154]



Ripping a long board is an easy, one-hand job. Just line up the cut marks with the table groove and hold the board in place with bridge clamps.

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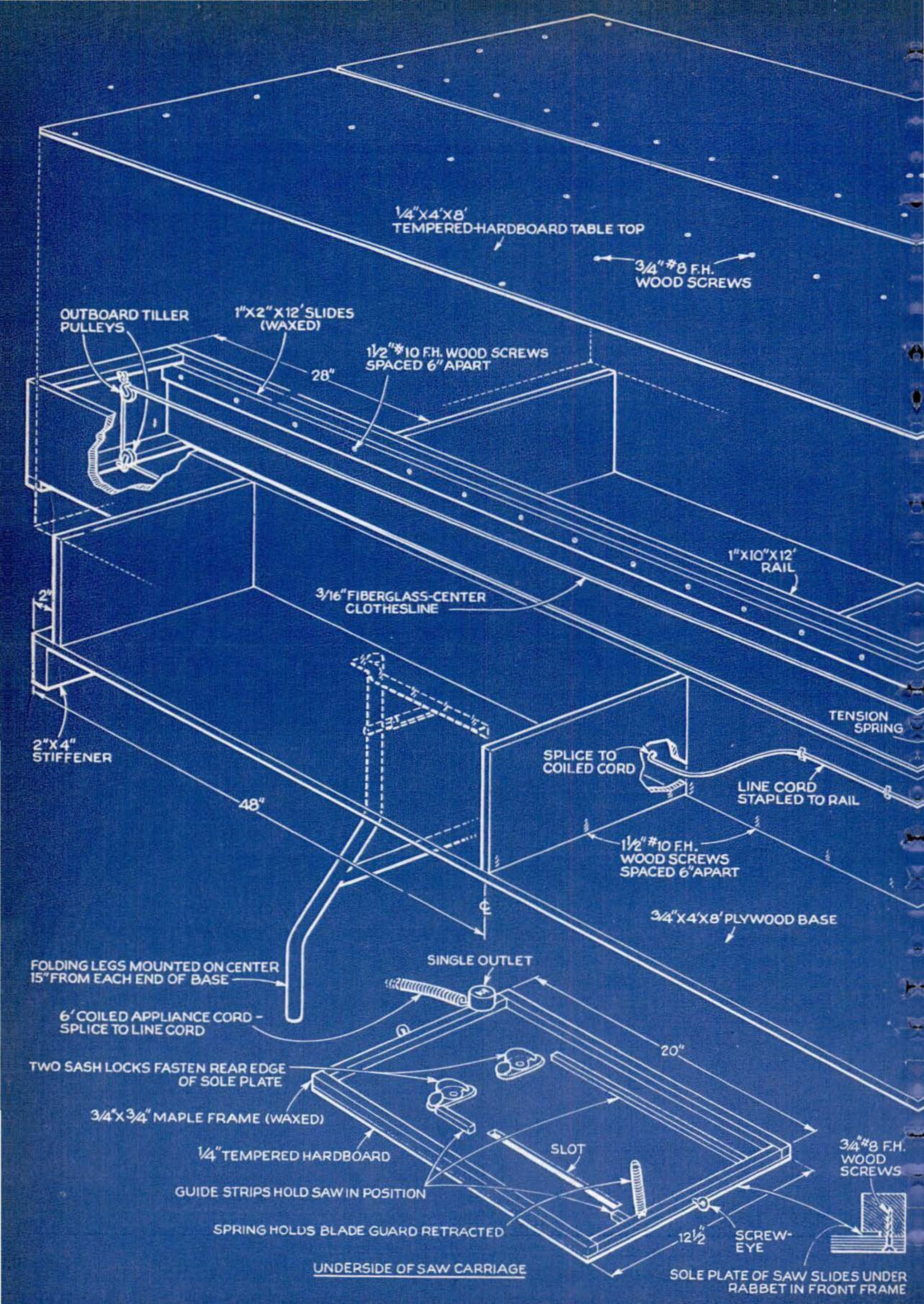
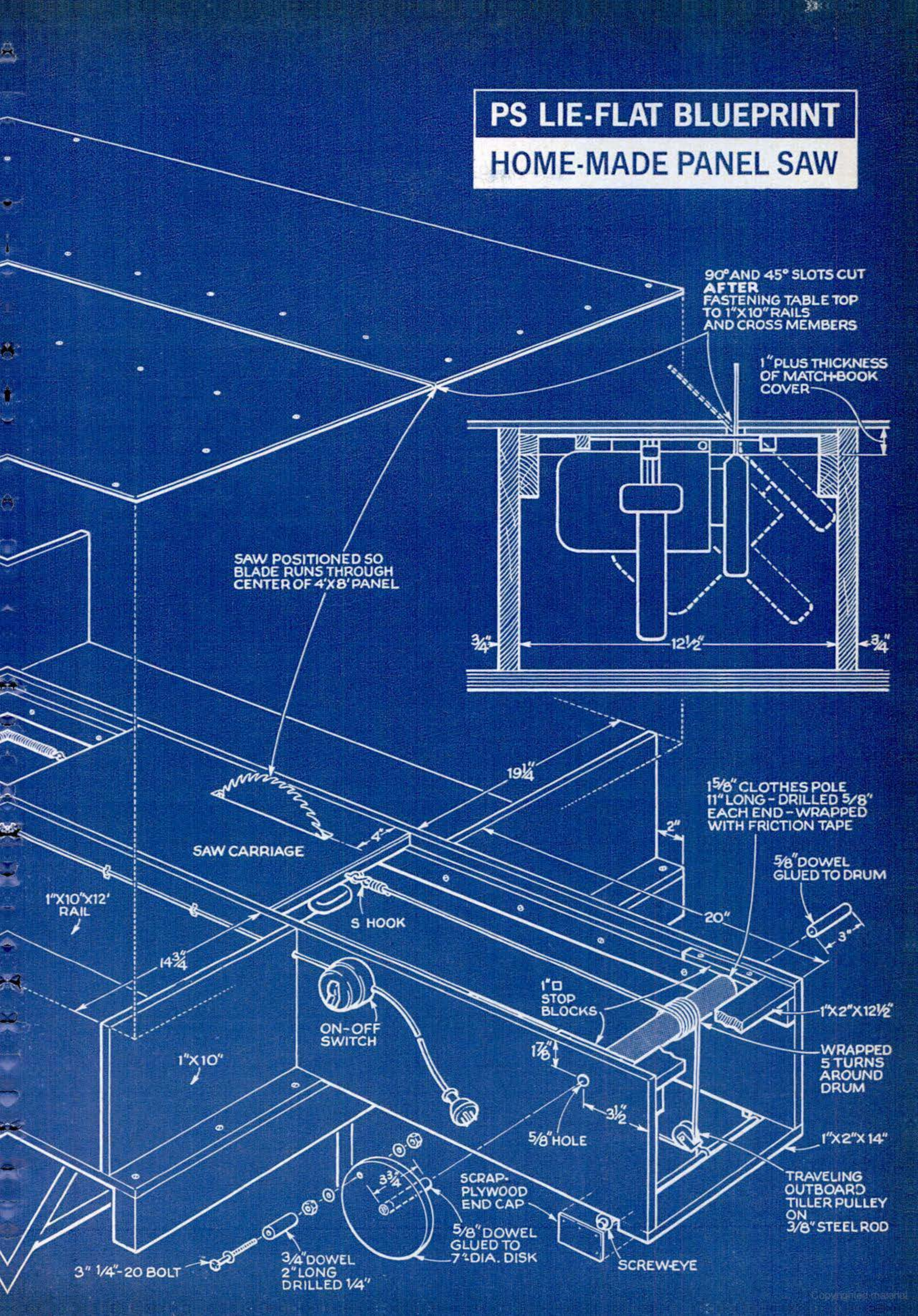

1/4"X4'X8'
TEMPERED HARDBOARD TABLE TOP
3/4" #8 F.H.
WOOD SCREWS
OUTBOARD TILLER
PULLEYS
1"X2"X12' SLIDES
(WAXED)
1 1/2" #10 F.H. WOOD SCREWS
SPACED 6" APART
28"
1"X10"X12'
RAIL
2"
3/16" FIBERGLASS-CENTER
CLOTHESLINE
2"X4"
STIFFENER
TENSION
SPRING
SPLICE TO
COILED CORD
LINE CORD
STAPLED TO RAIL
48"
1 1/2" #10 F.H.
WOOD SCREWS
SPACED 6" APART
℄
3/4"X4'X8' PLYWOOD BASE
FOLDING LEGS MOUNTED ON CENTER
15" FROM EACH END OF BASE
SINGLE OUTLET
6' COILED APPLIANCE CORD -
SPLICE TO LINE CORD
20"
TWO SASH LOCKS FASTEN REAR EDGE
OF SOLE PLATE
3/4"X3/4" MAPLE FRAME (WAXED)
1/4" TEMPERED HARDBOARD
SLOT
3/4" #8 F.H.
WOOD
SCREWS
GUIDE STRIPS HOLD SAW IN POSITION
SPRING HOLDS BLADE GUARD RETRACTED
12 1/2"
SCREW-
EYE
UNDERSIDE OF SAW CARRIAGE
SOLE PLATE OF SAW SLIDES UNDER
RABBET IN FRONT FRAME

PS LIE-FLAT BLUEPRINT

HOME-MADE PANEL SAW



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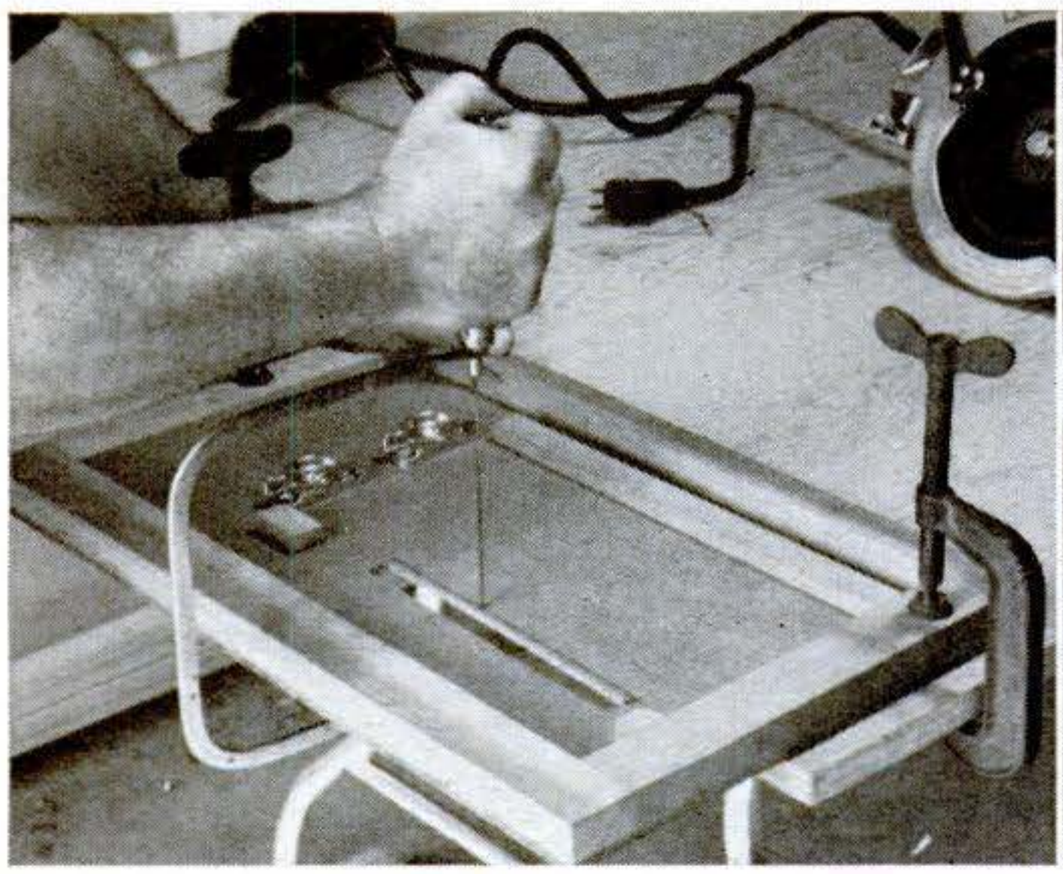
make the traveling saw a shop accessory that's easy to build and low in cost.

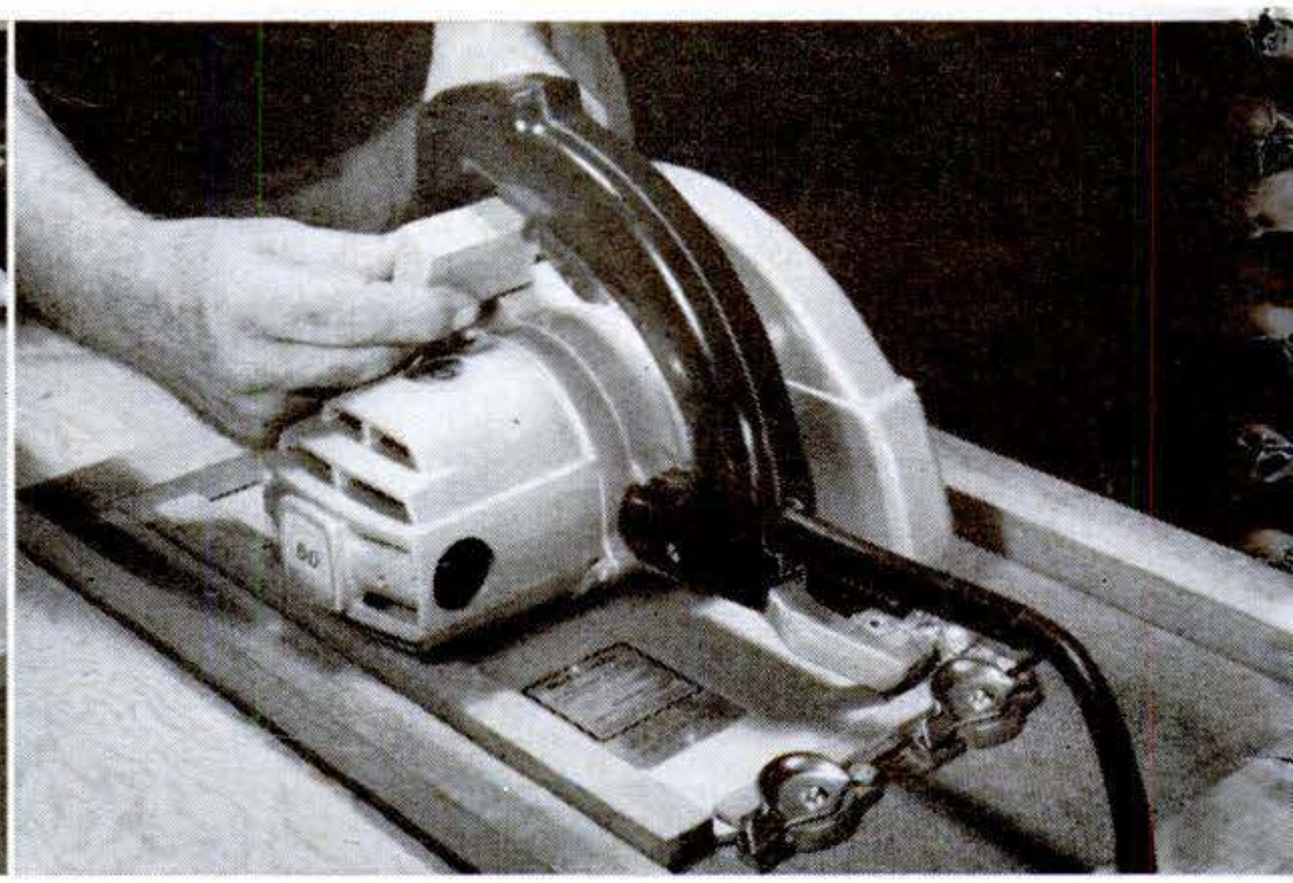
The saw shown in the photos is a husky Black and Decker 8″ one, but any portable saw will do. Fit your saw to the 12½″-by-20″ sliding carriage, using the drawing as a guide for positioning. Locate the blade 4″ from one edge as shown in the blueprint, so it centers in the table top. Align the blade carefully with the edge of the carriage; otherwise it will bind as it cuts, causing the blade to overheat and making cranking difficult.

The base and rails. Fasten the folding legs 15″ in from each end of a 4′-by-8′ panel of ¾″ plywood to provide a solid base for the saw table. Check to be sure the plywood is level at both ends and place a shim under one or more legs if the floor is uneven. The finished table should be simi-

Here are some important construction steps you should keep in mind when

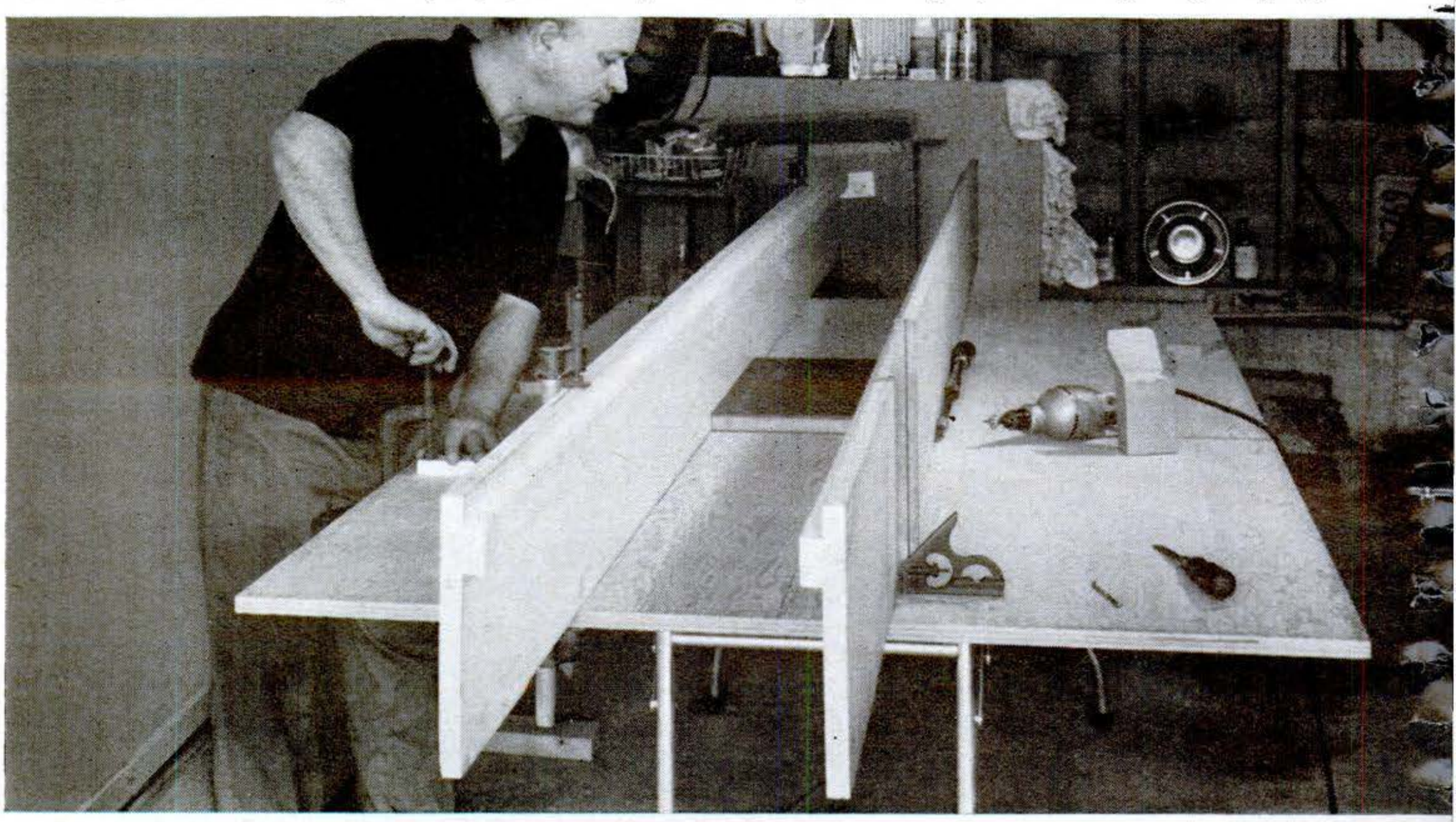


Carriage and saw blade must align: With saw locked parallel to the edges, lower blade to cut the slot. Coping saw widens slot to clear for a 45-degree cut.



Saw shoe plate clamps to the carriage with two sash locks. Trigger lock, or block of wood as shown above, keeps saw switch on. Second switch operates saw.

The side rails must be positioned accurately. Screw one rail down, using a straightedge to eliminate any bow. Use the saw carriage to space second rail; move the carriage along as you screw second rail to the base. Square-cut brackets hold the side rails in position. Again, the carriage is your gauge.



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larly leveled each time it's set up to insure smooth operation.

For the rails, select two straight 12′ lengths of one-by-10 clear pine and fasten a length of one-by-two pine to the face of each with 1½″ #10 flat-head wood screws spaced 6″ apart. Use a 1″ block of wood with a matchbook cover glued to it to space the one-by-two accurately from the top edge of the one-by-10 (the matchbook cover provides clearance, permitting the saw carriage to slide easily without binding). Bore ⅝″ holes as indicated for the crank and drum. Position one rail 19¼″ from the edge of the plywood base and overhanging it 20″ at the crank end. Screw the rail on from the underside of the base, using a straightedge to eliminate any bow in the rail as it is fastened.

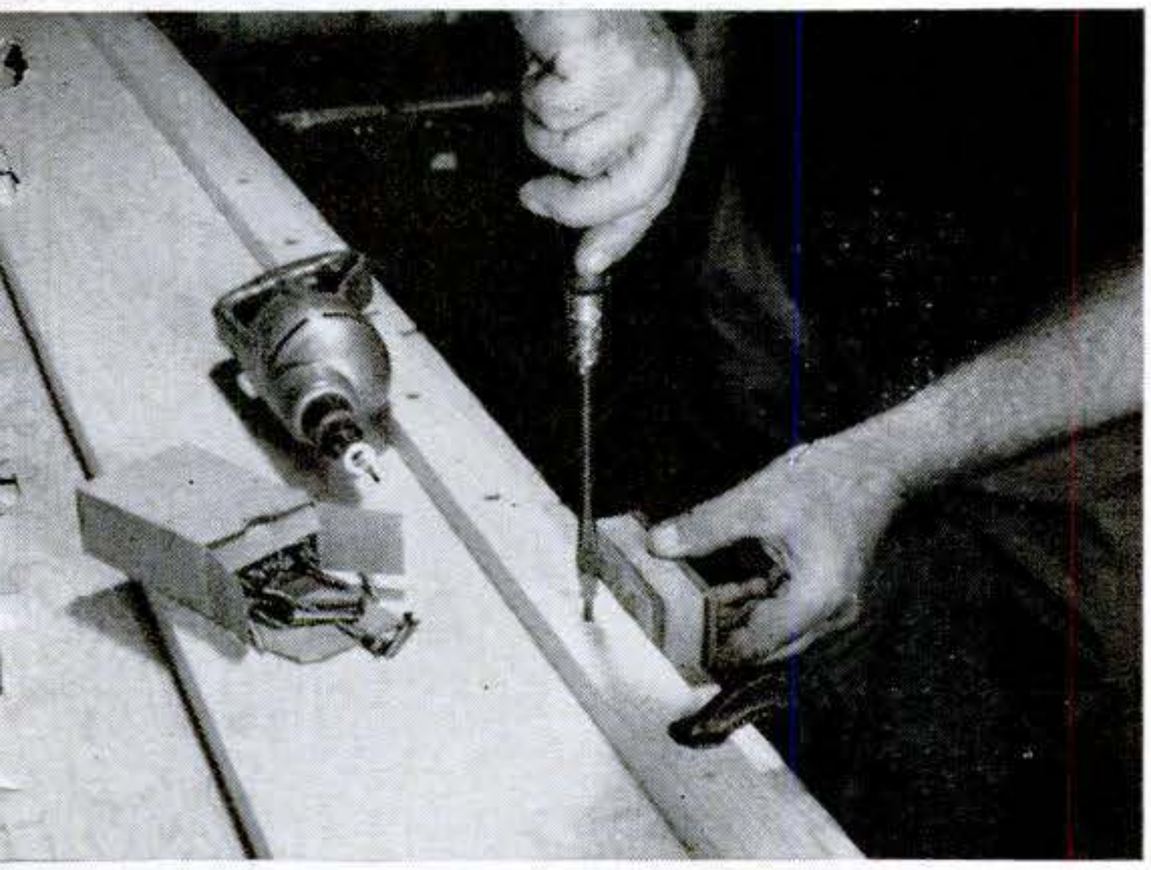
Place the saw carriage inside the first rail to establish the spacing of the second rail. Move the carriage along as the second rail is screwed to the base to maintain uniform separation. Cut six one-by-10 brackets and screw them in position to hold the rails square and plumb. Slide the saw carriage along the one-by-twos and adjust the brackets by tapping them in or out with a hammer until the carriage slides easily and with little side play.

Crank feed. Make the crank from a 7″-diameter disk of clear pine and glue a 3¾″ length of ⅝″ dowel in a hole bored in its center. A 2″ length of ¾″ dowel rotating on a ¼″-20 bolt double-nutted to the disk serves as a sturdy crank handle.

For the drum, cut an 11″ length of 1⅝″ closet pole and bore a ⅝″ hole 1½″ deep in each end. Apply glue to both holes, set

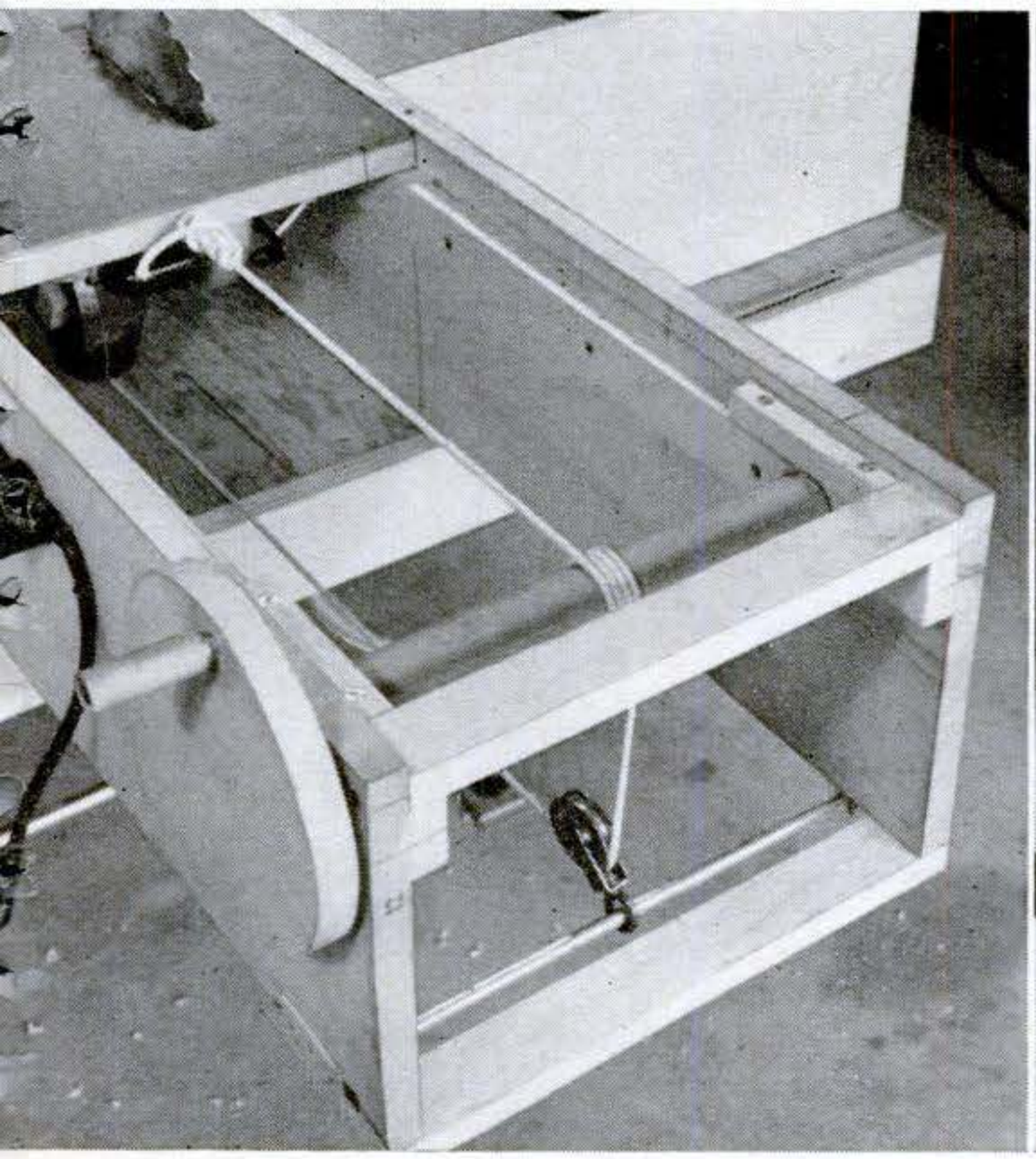
[Continued on page 192]

uilding the traveling panel saw

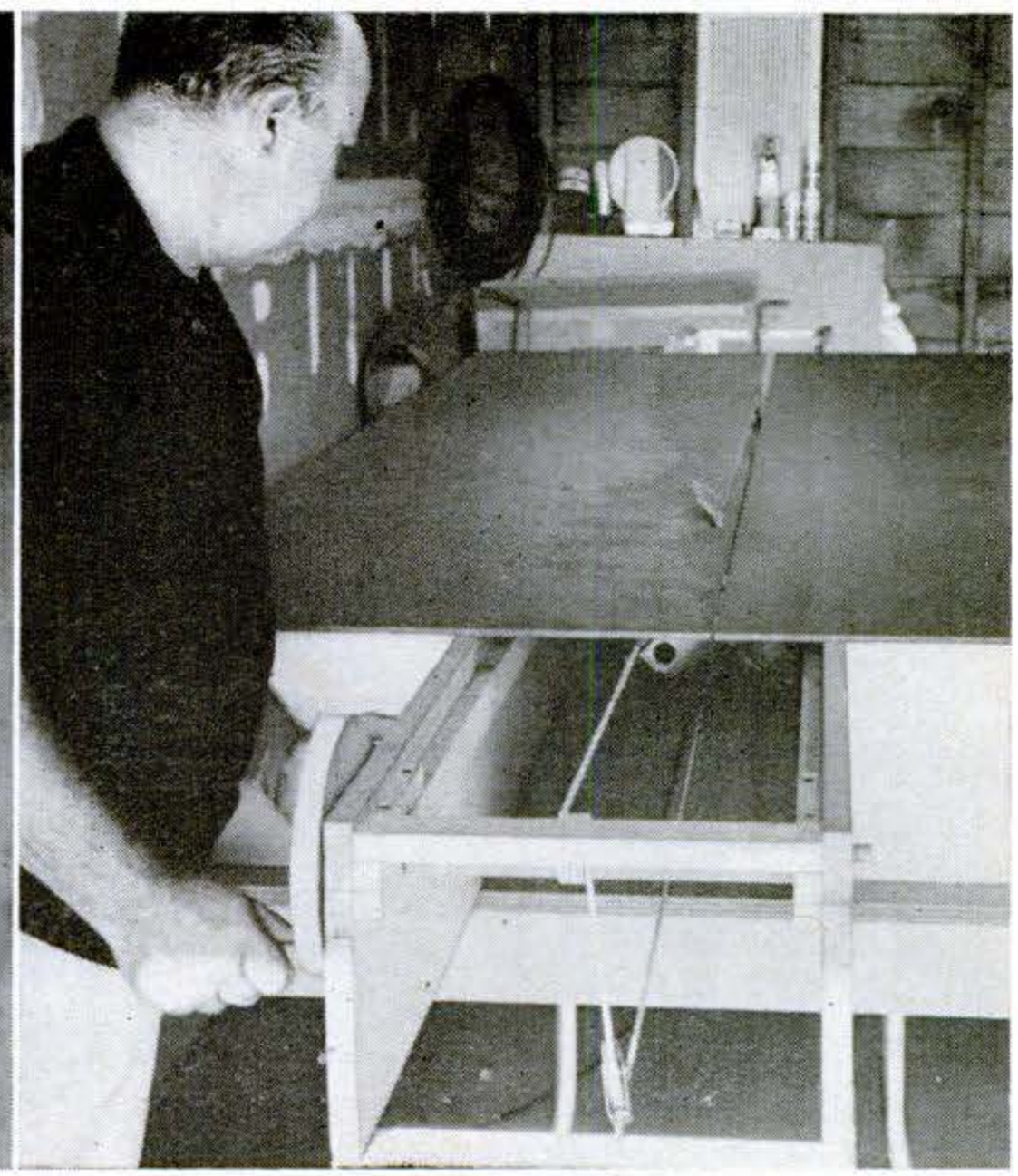


Slides must be accurately spaced from top of the side rails. A 1″ block of wood plus the thickness of a matchbook cover gives proper sliding clearance.

Operating end of the panel saw holds the on-off switch that operates the saw, and the hand crank that winches the saw carriage back and forth.



The saw-table groove is the first cut made after the table top is screwed on. The 90- and 45-degree cuts in the top are used to align stock to be cut.



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Untreated concrete exposed to freezing temperatures can look like this scaled garage floor after a couple of seasons. Road salt and other de-icing chemicals dripped off cars often aggravate scaling.

How to Guard a Driveway from Winter Damage

If you live in the snow belt, your concrete driveway may need protection against damage caused by thawing and freezing. Concrete contains microscopic pores that soak up water. When the water freezes, it can expand with enough pressure to chip away the surface of the concrete.

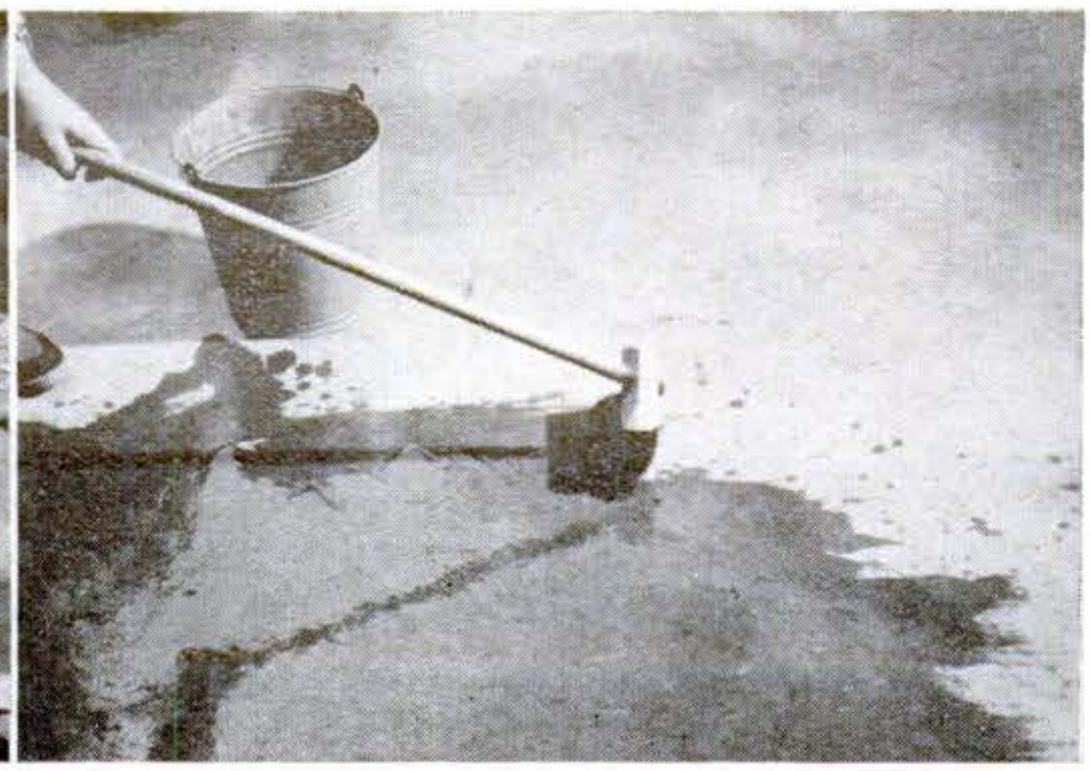
This common problem, called scaling, is easy to prevent. A 50/50 mixture of linseed oil and turpentine or mineral spirits will penetrate the concrete and seal out moisture. If your drive shows signs of scaling, a treatment is in order. Six dollars buys enough to protect the average driveway, and the treatment lasts for years.

Put the coating on in two thin coats. Spraying is the easiest way. You can use either a paint sprayer or a tank-type garden sprayer. Brushing is more work, and thin coats are harder to apply.

Recommended coverage for the first coat is 360 square feet per gallon of mixture. The second coat is thinner—about 600 feet per gallon. Sweep the surface clean and make sure it's dry. Don't worry about oil drippings; they provide scale resistance of their own.

Don't apply the mixture when the temperature is below 50 degrees, or on concrete that hasn't cured at least a week or two. Air-entrained concrete does not ordinarily require any treatment.—*Russ Douglas.*

Best antiscale treatment for concrete, says the Highway Research Board, is a 50/50 mixture of linseed oil and mineral spirits. Turps can do for spirits.



Brush, spray, or roll the mixture on in two thin coats, a day apart. Treatment will protect new concrete and concrete that has already started to scale.

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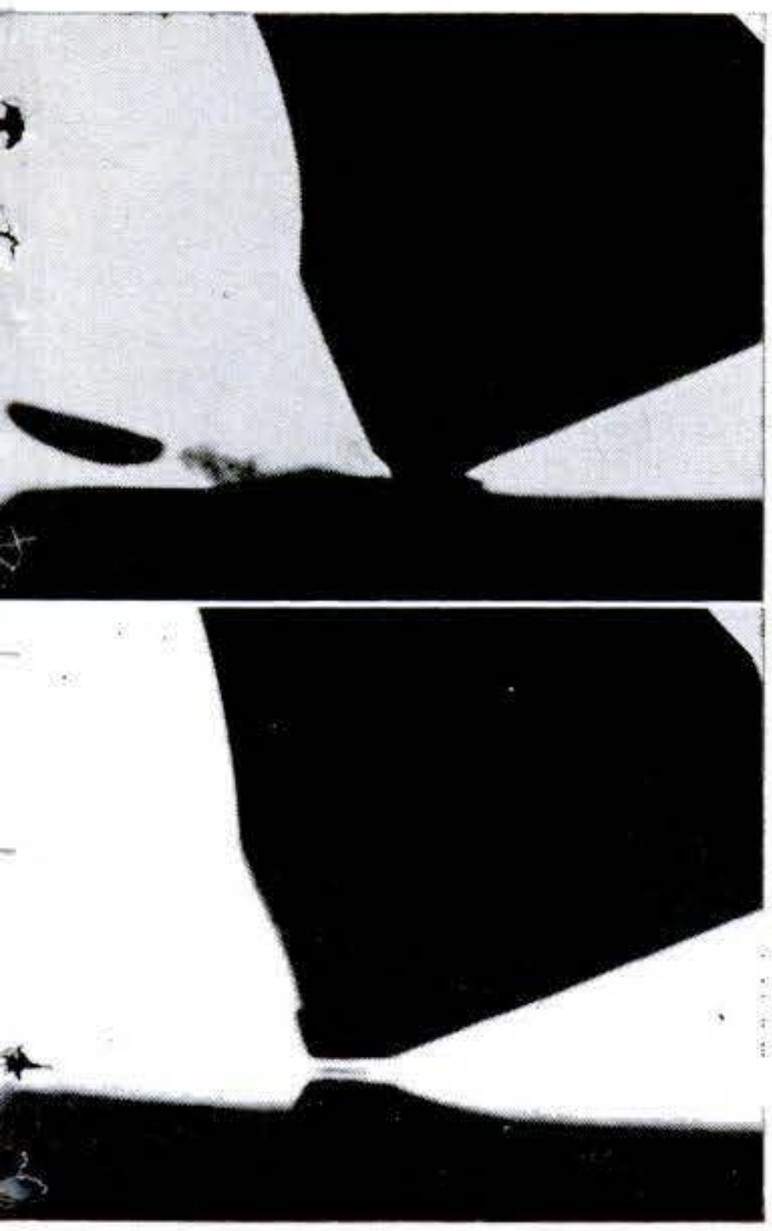
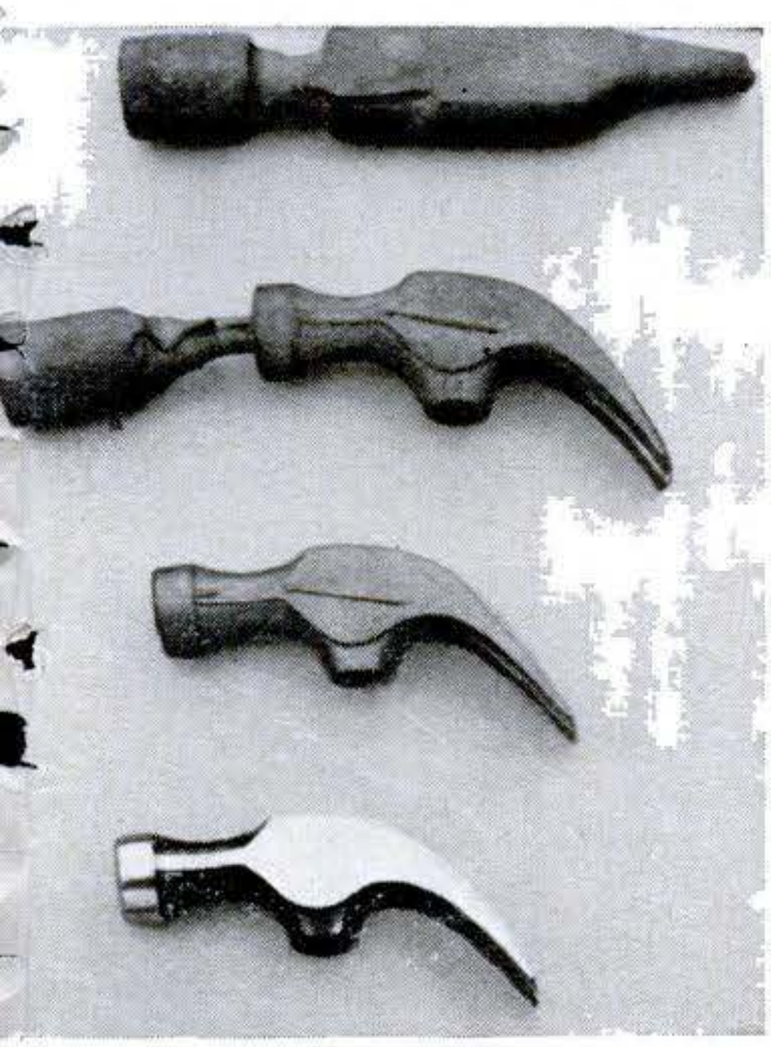
Shop Talk

By ROBERT P. STEVENSON

How is a safe hammer made? Here's how one maker does it





Everyone knows that the striking face should meet a struck object squarely. But that isn't always possible, and an area along the rim may have to absorb the full blow—with the result that a chip may break off.

To keep fly-away slivers to a minimum, the Stanley Tools people rim-temper their better hammers. The general face hardness ranges between C53 and C57 Rockwell. But around the rim, the hardness is reduced by tempering to about C45 Rockwell. To show the results, high-speed photos were taken some time ago in the Stanley labs. The top photo shows a fragment flying off the edge of a regular hammer when a foul blow was struck on an anvil. The photo below it shows the same hammer after rim tempering. A spall formed on the edge, but did not detach.

The bottom photo shows stages in drop forging of a new Stanley solid-steel hammer from a bar of high-carbon steel. There are eight heat-treating operations. Face and claws get individual treatment.

Other tool notes: Black & Decker has introduced a 6" Quick-Set dado for radial-arm and table saws. You turn it to adjust for any width from ¼" to 13/16" . . . You use your own motor with a new portable spray gun and compressor from Thomas Industries, Inc., Louisville, Ky. Price, about $40.

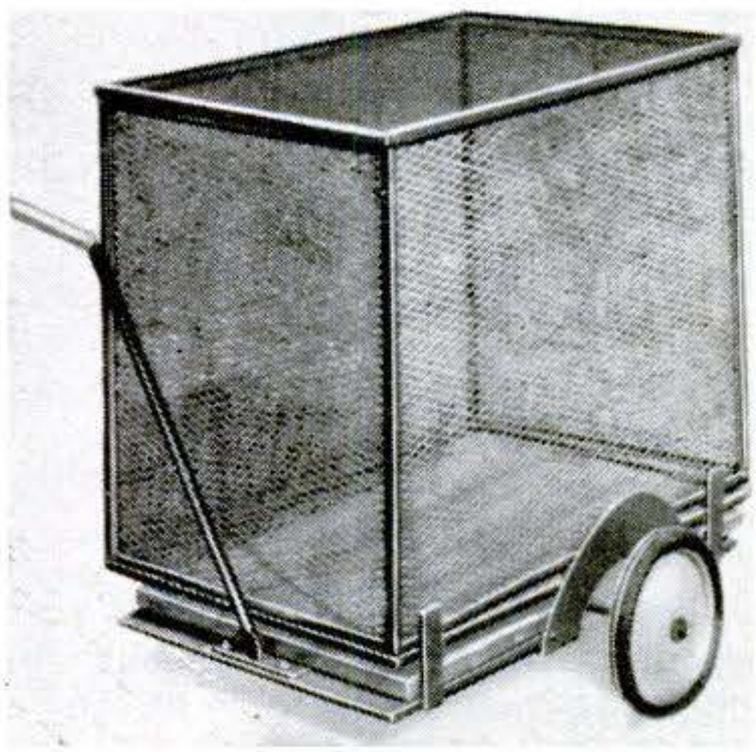
Fingertip fuel primer puts '67 mower off to faster start

Among many noteworthy features you'll find on Toro's 1967 19-inch rotary mower is a primer that you press to put gasoline directly into the combustion chamber before pulling the starting cord.

In yard cleanup, you can now cart the fire to the leaves

Portable incinerators now on the market for easier yard cleanup remind me of the Saturday morning some autumns ago when my old wooden wheelbarrow turned up missing. Where was it? No one knew. Hours later I recalled that a week before, I had been called to the phone just as I wheeled it full of leaves to the fire site at the back of the lot. And that's where I found what was left of it—just the iron wheel and axle.

You can't burn up the new leaf carts. They're made entirely of metal. An example is the Osrow Fire Cart, right, made by Osrow Products Co., Hazel Street, Glen Cove, N.Y. You burn the leaves in it, right on the lawn if you wish. A removable pan makes it easy to dispose of ashes.



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Preventive maintenance and regular tune-ups can help you avoid breakdowns. Here's how you can be sure you're getting what you pay for

Secrets for Getting the Best Engine Tune-Up

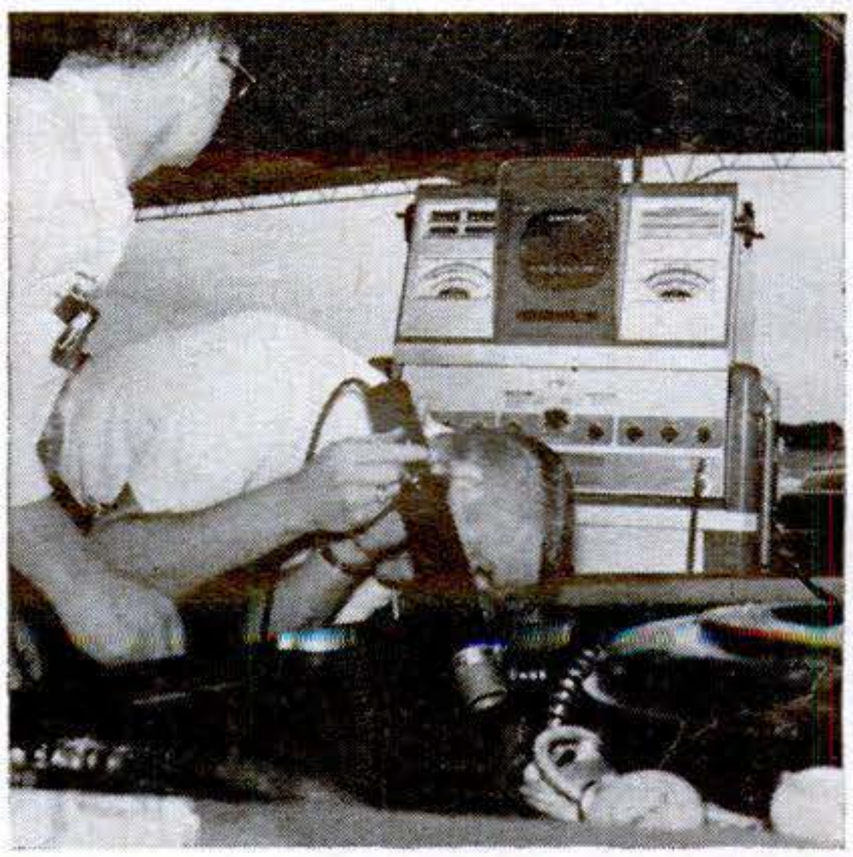
By RICHARD DAY

Let's settle one thing first: They have not yet learned how to make a car engine that will run indefinitely without periodic service. There are a few vital parts that wear, erode, burn, stretch, clog, foul, or corrode enough in a few thousand miles of driving to impair your engine's efficiency and dependability. Just how far you can drive before this "normal" wear and tear seriously affects your car's performance depends mainly on how and where you drive.

Most car manufacturers, dealers, and mechanics call the corrective and preventive procedures that are designed to cope with these routine problems a "tune-up." But no two establishments seem to agree on just what a tune-up is. Your corner gas station may advertise "Spring Tune-Up for $9.95" while the mechanic down the street charges $25 for what *he* calls a tune-up. The difference may be entirely in the number of specific services and parts that are included in the blanket charge.

So here's your first rule for getting your money's worth when you buy a tune-up: Have your mechanic spell out exactly what he will do for the agreed-upon price. *Continued*

In a diagnostic center, the car is run on



A good mechanic always checks the contact-point dwell angle with a dwell meter while the engine is running before he makes any adjustments to the ignition timing.

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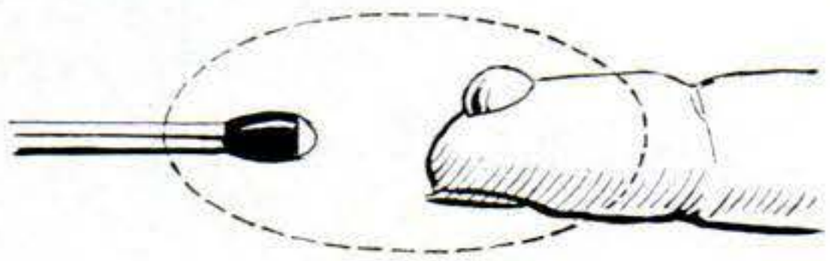
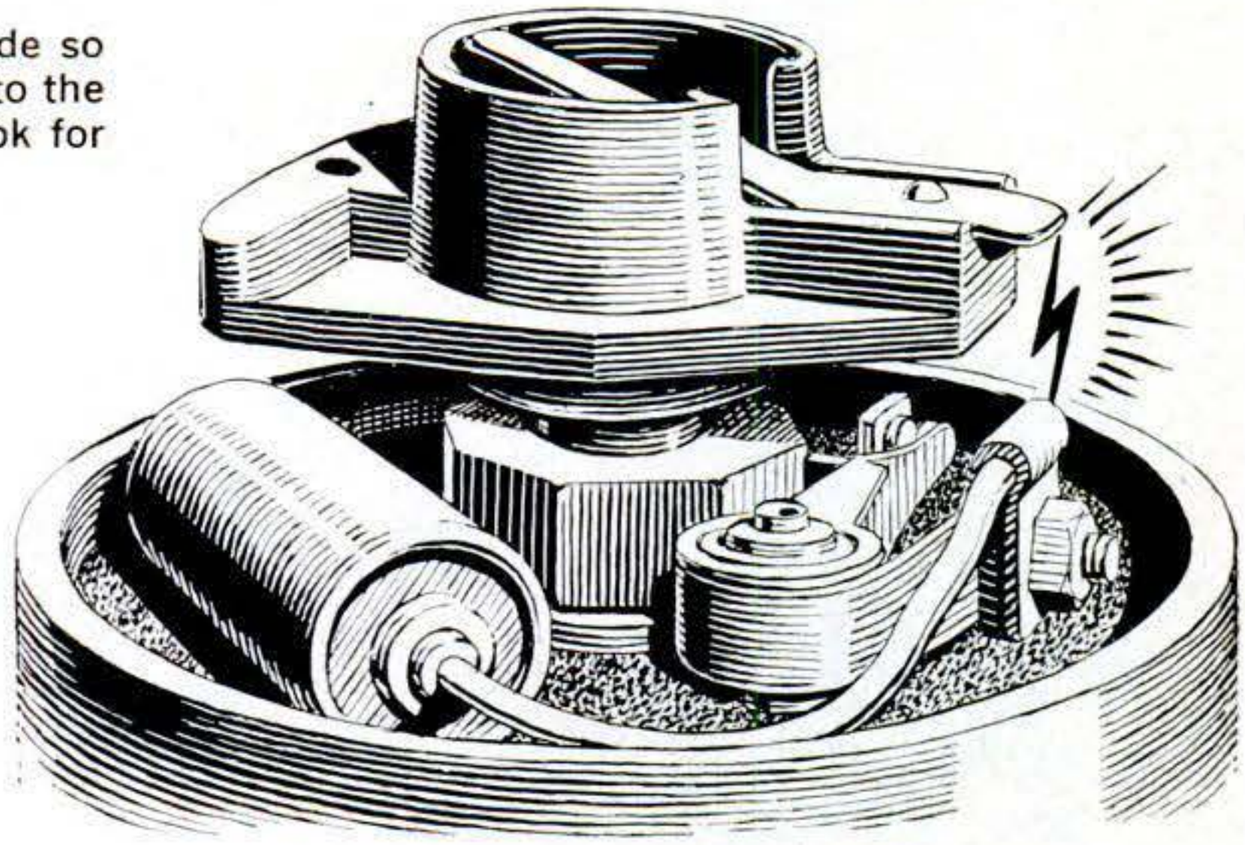
dynamometer while engine is analyzed under normal load. Dials show power, vacuum, air-fuel ratio.

When new points are fitted, the lugs may ride so high that the spark can jump from the rotor to the lug. It's not on anybody's check list, but look for this if trouble persists after tune-up.



Use a lump of distributor-cam grease no larger than the head of a kitchen match when points are replaced, to prevent excessive rubbing-block wear.



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Modern tune-up centers use many electronic test instruments, such as this transistorized tach-dwell ignition tester. It will analyze the complete ignition system with one single hookup.

What do you need? The typical "bargain" tune-up job consists of replacing the spark plugs, breaker points, and condenser, retiming the spark, and adjusting the idle speed. If you're lucky, this so-called tune-up may cure the trouble that brought you into the shop—at least temporarily. But if your engine still misbehaves, most of the money has been wasted. This kind of job gives you no assurance that your engine won't stall in traffic, fail to start, overheat, or act boorish in a half-dozen other ways that could have been prevented by a thorough inspection and complete diagnosis.

Your second rule, then, for a dependable tune-up job is to shop for a complete job that includes inspection, testing, routine replacement, cleaning, and adjusting of your engine's vital parts.

A complete tune-up covers five areas:

1. Engine-compression, cylinder balance, cylinder leakage, air cleaner, intake-manifold leakage, manifold vacuum, heat riser, and exhaust flow.

2. Fuel system: carburetor, fuel pump, filter, and PCV valve.

3. Ignition system: coil and coil polarity, condenser, points, distributor (including centrifugal and vacuum advance), rotor and cap, wiring, and spark plugs.

4. Starting system: battery and cables, starter solenoid, and starter motor.

5. Charging system: generator (alternator), voltage regulator, and battery.

Your third rule covers the tools and equipment in the tune-up station. The more modern tune-up equipment your mechanic has, the better. An expert may be able to do a good job without electronic diagnostic instruments, but it will take him a lot longer.

Here's what to look for: A set of manufacturer's specifications for your engine—without this, don't let anyone touch your car. Vacuum gauge and compression gauge. Timing light. Tachometer and dwell meter. Battery tester and charger. Volt-ampere meter. Spark-plug tester and cleaning machine. Distributor machine. Coil-and-condenser tester. Oscilloscope (a TV-like instrument that paints a picture of your entire ignition system).

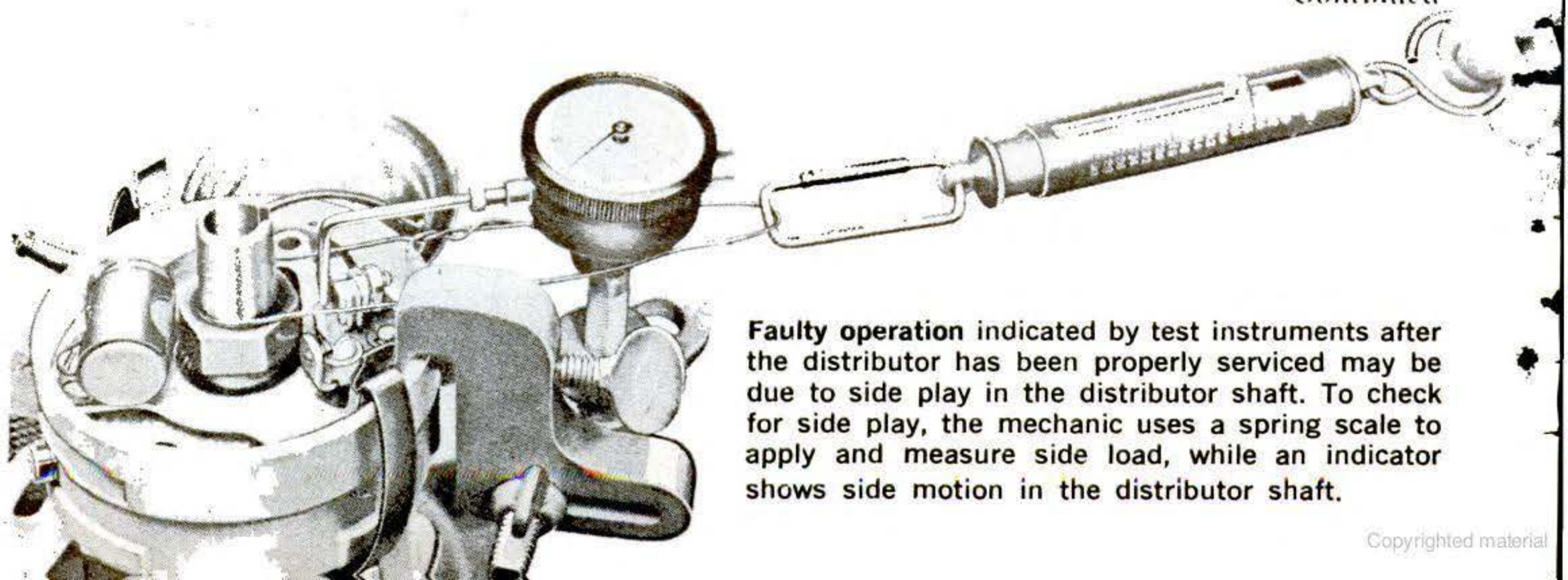
How to check a tune-up. Now you come to rule number four: Make 10 easy checks after the tune-up. If you're not satisfied on all points, go back and have the trouble rectified as part of the job you paid for. If your car passes all the tests, you got a good tune-up.

1. Look at the battery terminals. If they're not clean, the tune-up is not complete.

2. Jiggle the counterweight for the heat-riser valve with your hand. The shaft should turn freely.

3. Start the engine. If the starter grinds

Continued



Faulty operation indicated by test instruments after the distributor has been properly serviced may be due to side play in the distributor shaft. To check for side play, the mechanic uses a spring scale to apply and measure side load, while an indicator shows side motion in the distributor shaft.

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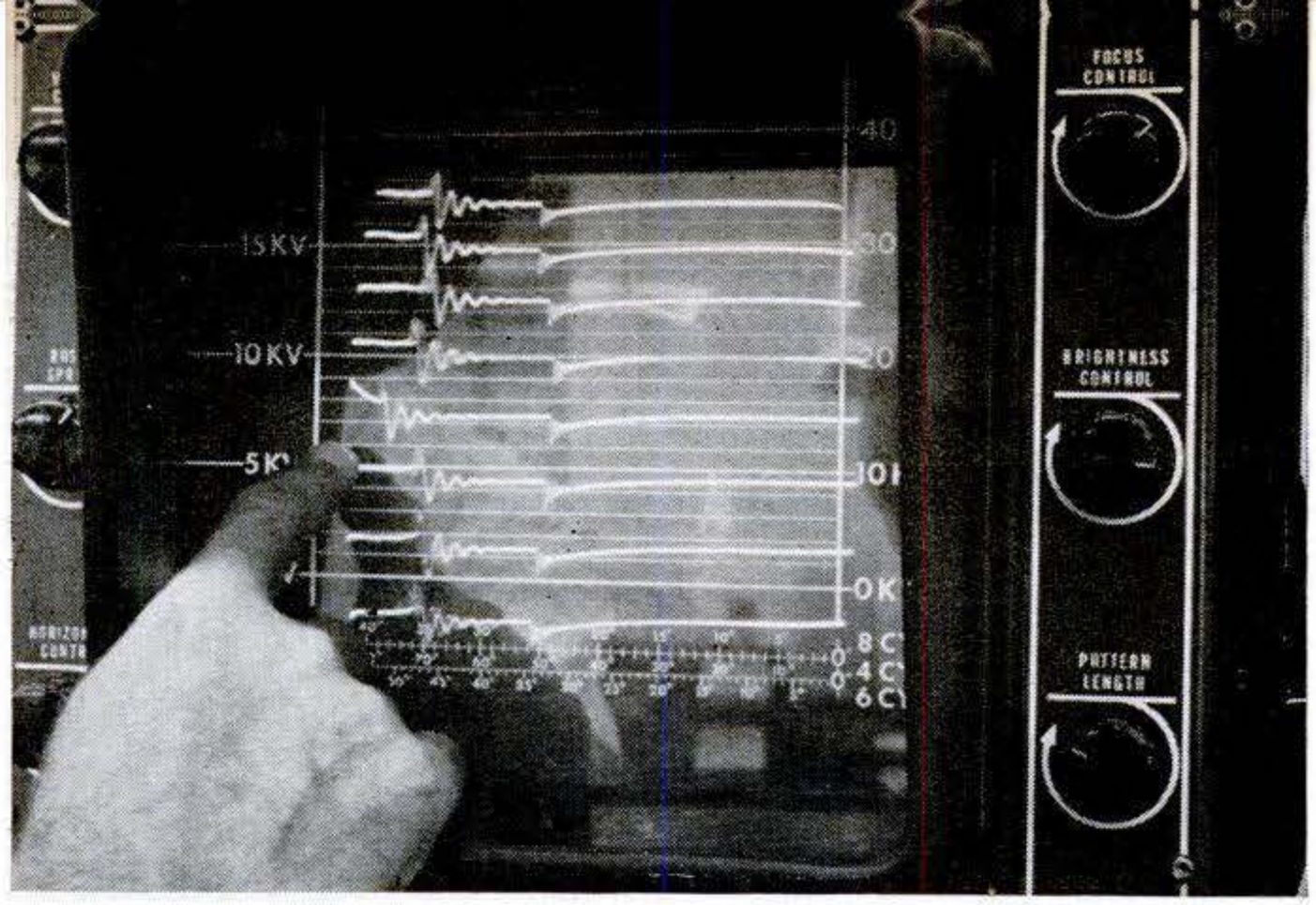
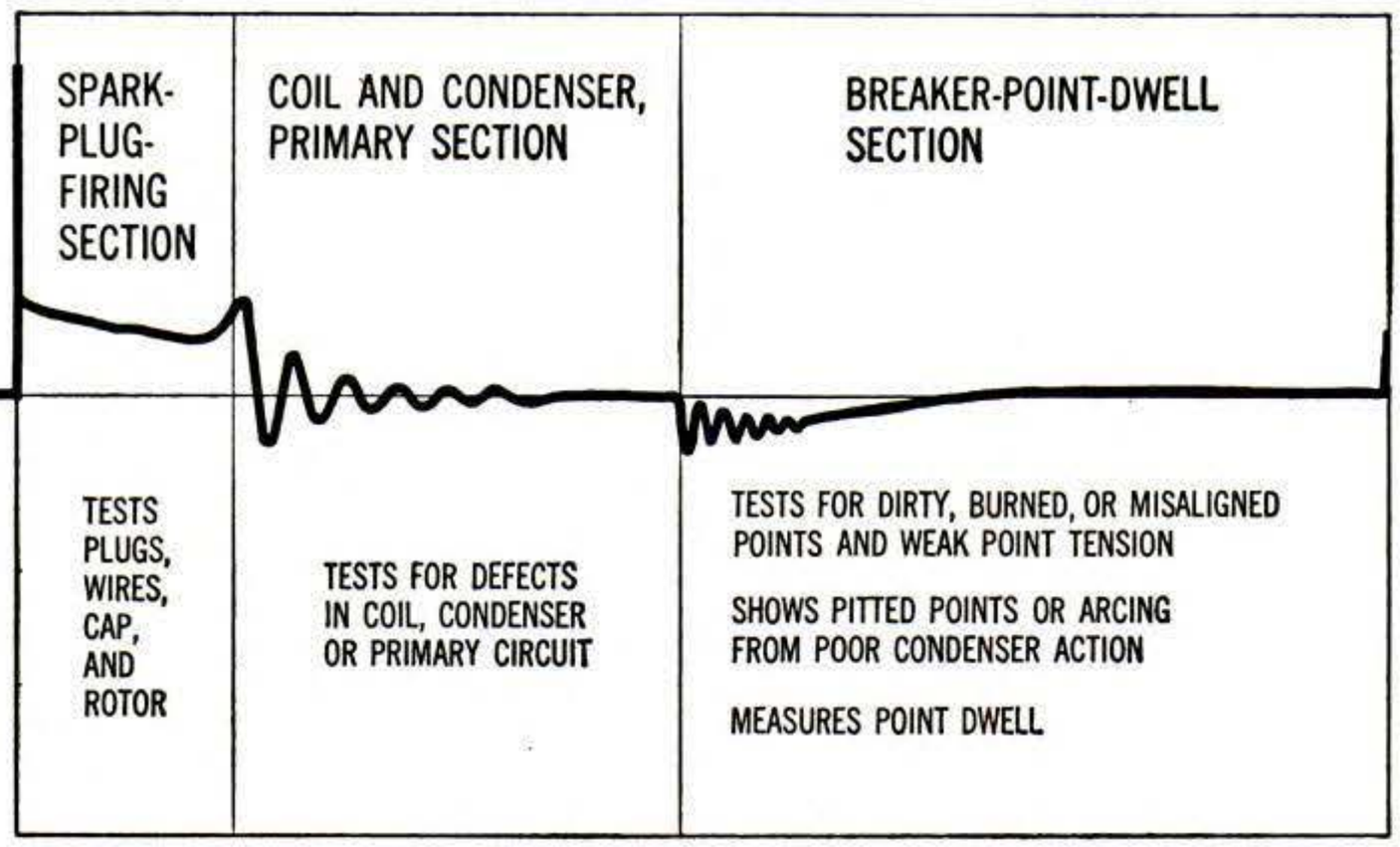
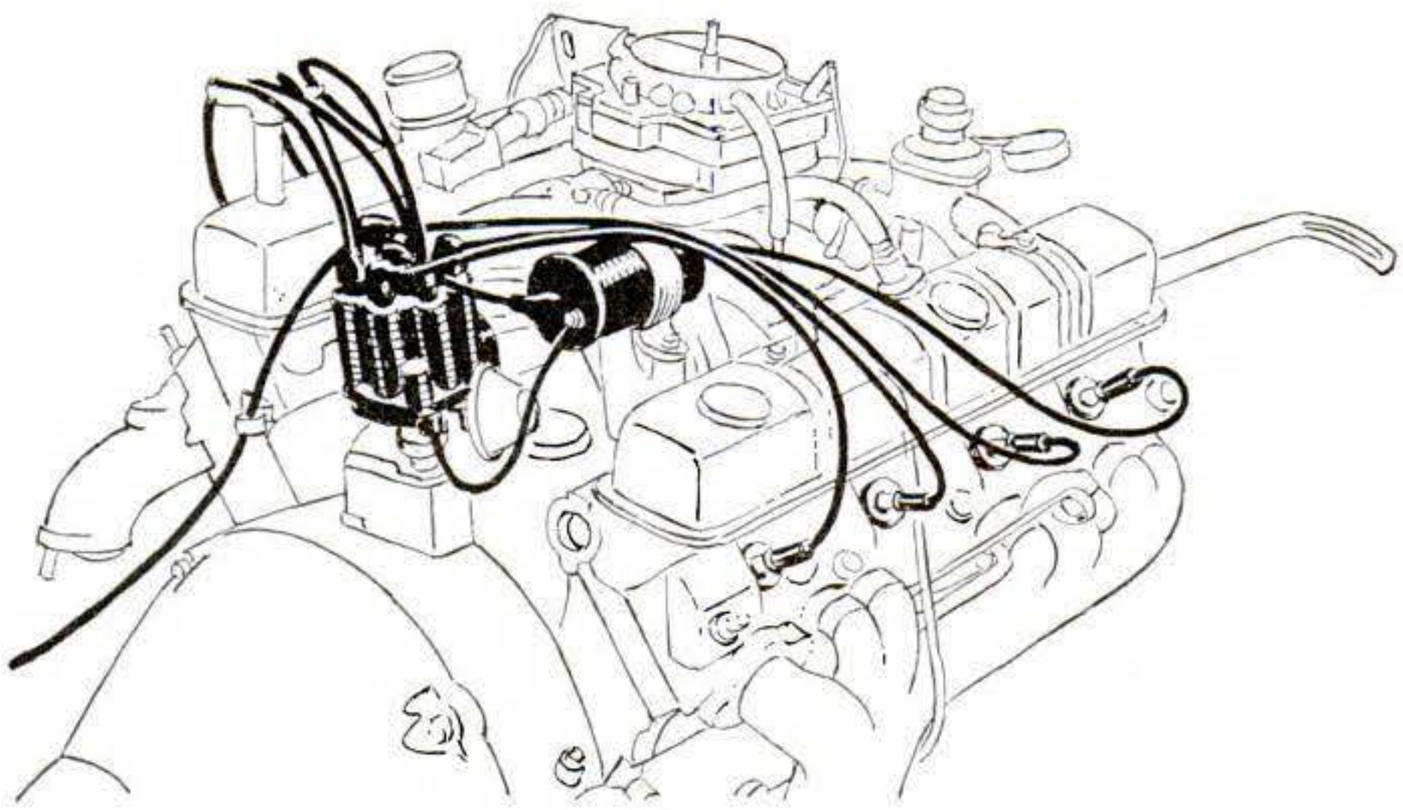


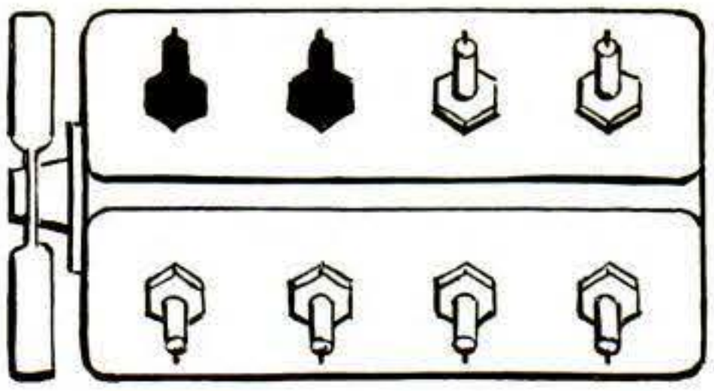
Oscilloscope is basically a voltmeter with a dynamic scale. The TV screen gives a graphic indication of what's going on inside all eight cylinders at the same time. See scope pattern below.



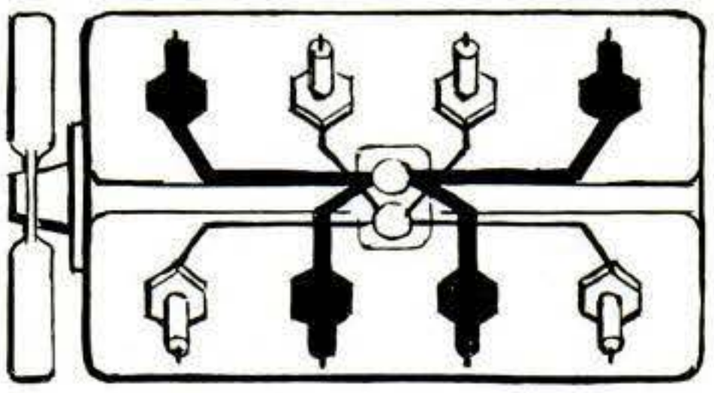
Oscilloscope shows condition of coil, condenser, plugs, wires, rotor, distributor cap, and even engine compression. This is the correct secondary pattern for one cylinder's ignition cycle. The wiggly line represents voltage variations. A trained mechanic can read the pattern the way a doctor reads a patient's electrocardiogram. The line begins (left) with high voltage as the points break. Voltage drops when the spark is generated. After sparking, energy remaining in coil and condenser is dissipated. Dwell section begins with voltage drop, oscillations follow. Look for an oscilloscope in your shop.



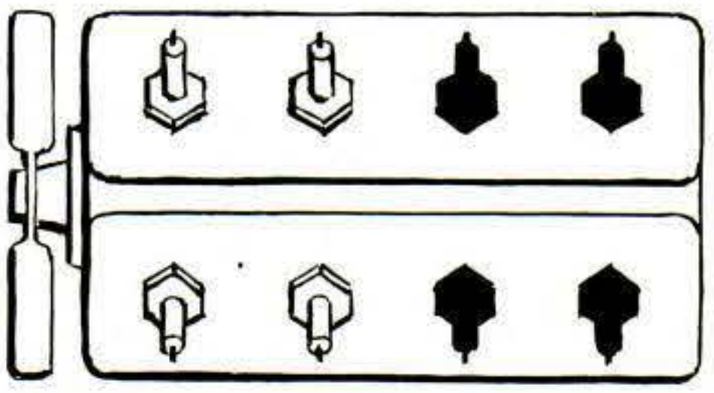
All connections should be checked by mechanic—if he's a good one—before the ignition system is placed under analysis. Special points: plug leads and distributor and coil wires.



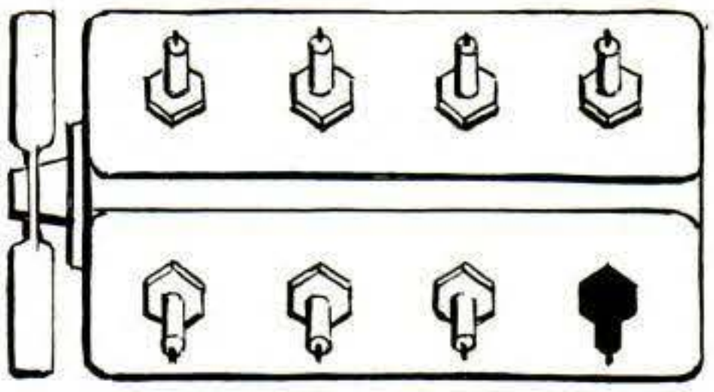
Black dots on these V-8 engines represent fouled spark plugs. If two adjacent plugs are fouled, check compression—suspect blown cylinder-head gasket.



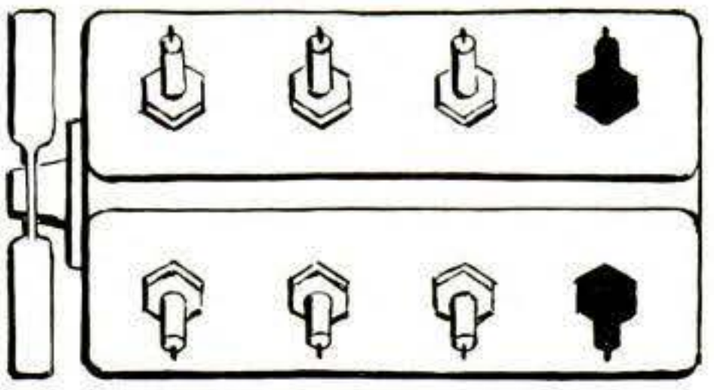
Four fouled plugs indicate an unbalanced carburetor (black lines indicate gas flow). This pattern may occur if one barrel is adjusted to run over-rich.



Four overheated plugs in the back four cylinders? Probable cause: restrictions in coolant circulation. Solution is simple: Flush the entire cooling system.



Just one plug overheated? Check firing order. Also suspect crossfire to overheated plug from plug that fires just before it. Solution: Separate the plug leads.



Two rear plugs fouled? Suspect sludge blocking oil drain holes in cylinder head. Oil may be leaking in through valve guides. Symptom to look for: black exhaust.

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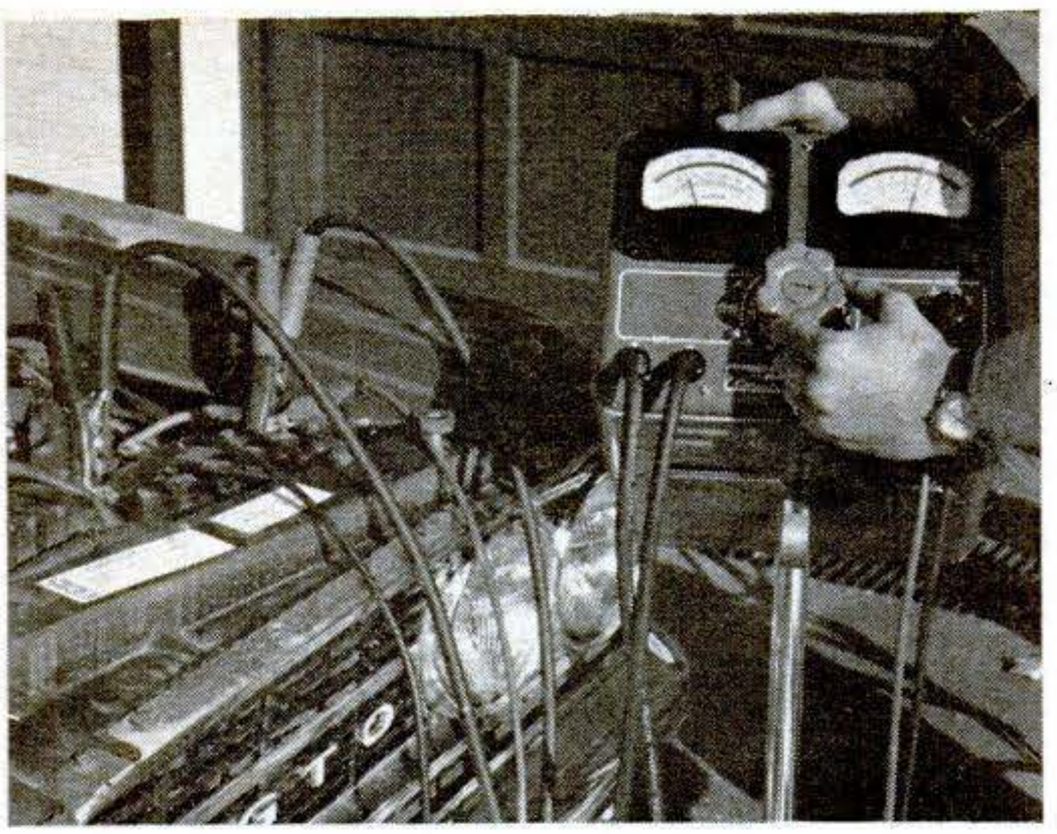
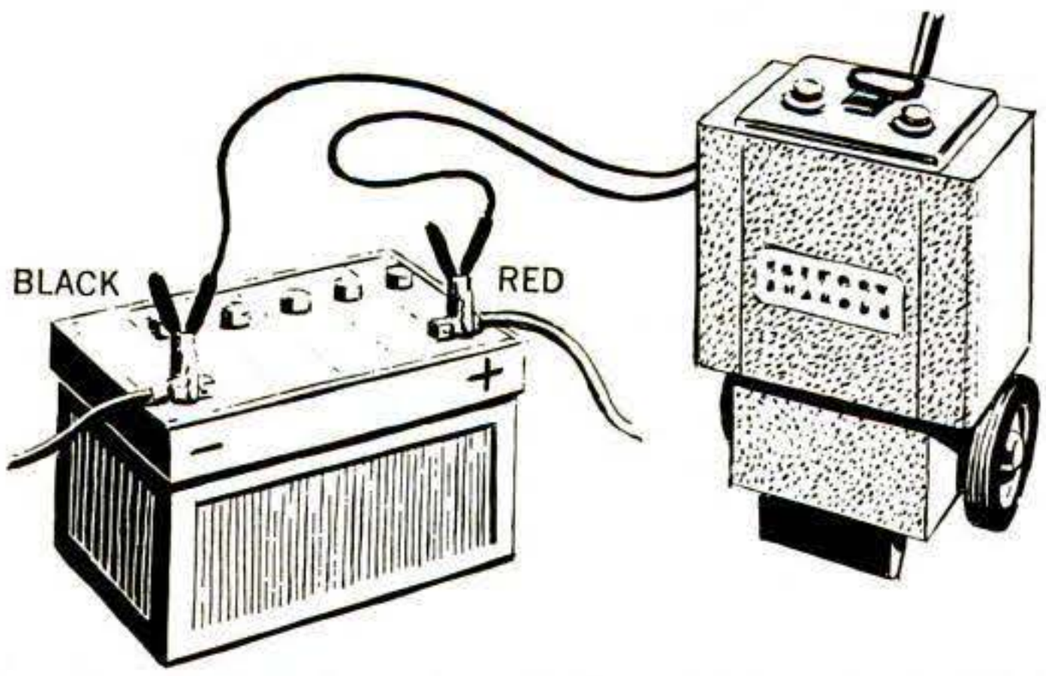


Battery condition is checked with a volt-ampere meter with built-in variable resistance. Voltage is read while the battery is put under a load three times its ampere-hour rating.



Need charging in a hurry? Your battery may, this winter. Fast-charging is safe with a 50-ampere charge over 20 minutes. But too high a current will cause permanent damage to the plates.

To check abnormal battery charging on alternator-equipped cars, use a diode tester to locate leaking, shorted, or dead diodes. Reversed polarity is the most common cause of diode failure.

away for more than 10 seconds, something is still wrong.

4. With engine idling, place a piece of thin plastic film over the breather pipe to check the PCV system. If there's no sign of suction, the PCV valve is clogged.

5. Check for normal warm-up. The engine should run on fast idle from two to five minutes (depending on weather).

6. After warm-up, if the engine lopes, gallops or races, take the car back.

7. If you have an automatic transmission, engage Drive and watch for creep at idle. Creeping means idle is too fast.

8. If you have a manual transmission, start off in top gear with the engine idling. Give gas gradually and watch for flat spots, roughness, or surge, indicating faulty carburetor or ignition settings.

9. Floor the accelerator suddenly when running at idling speed in top gear. There should be no bucking—a flat spot indicates a malfunction in the accelerator pump. Excessive pings or knocks indicate that ignition timing is too far advanced.

10. Stop dead from 20 m.p.h. If the engine stalls, get the fuel system and carburetor settings rechecked.

More tips. There are a few more secrets you should know. Don't be upset if the engine seems to lose some of its tune after 100 miles or so. As a rule, this only means that the rubbing block has worn in and the point gap needs to be readjusted.

Knowledgeable car owners like to look at the old plugs when a new set is fitted. Fouled or overheated plugs are a sign of other disorders. Catching them in time can avert big engine trouble later on.

Looking at old plugs is also a way to make sure they've all been replaced. On cars where it's troublesome to get at certain plugs, mechanics don't always bother to change them. If spark plugs can be cleaned and pass the test, they need not be replaced.

To sum up, there are four main rules for getting the best engine tune-up:

1. Have the mechanic spell out what his tune-up job covers.

2. Don't buy it unless it's a complete tune-up.

3. Look over the tune-up equipment. Go elsewhere if the shop hasn't got the necessary tools and instruments.

4. Make 10 easy checks after the tune-up and don't give up until you're satisfied. PS

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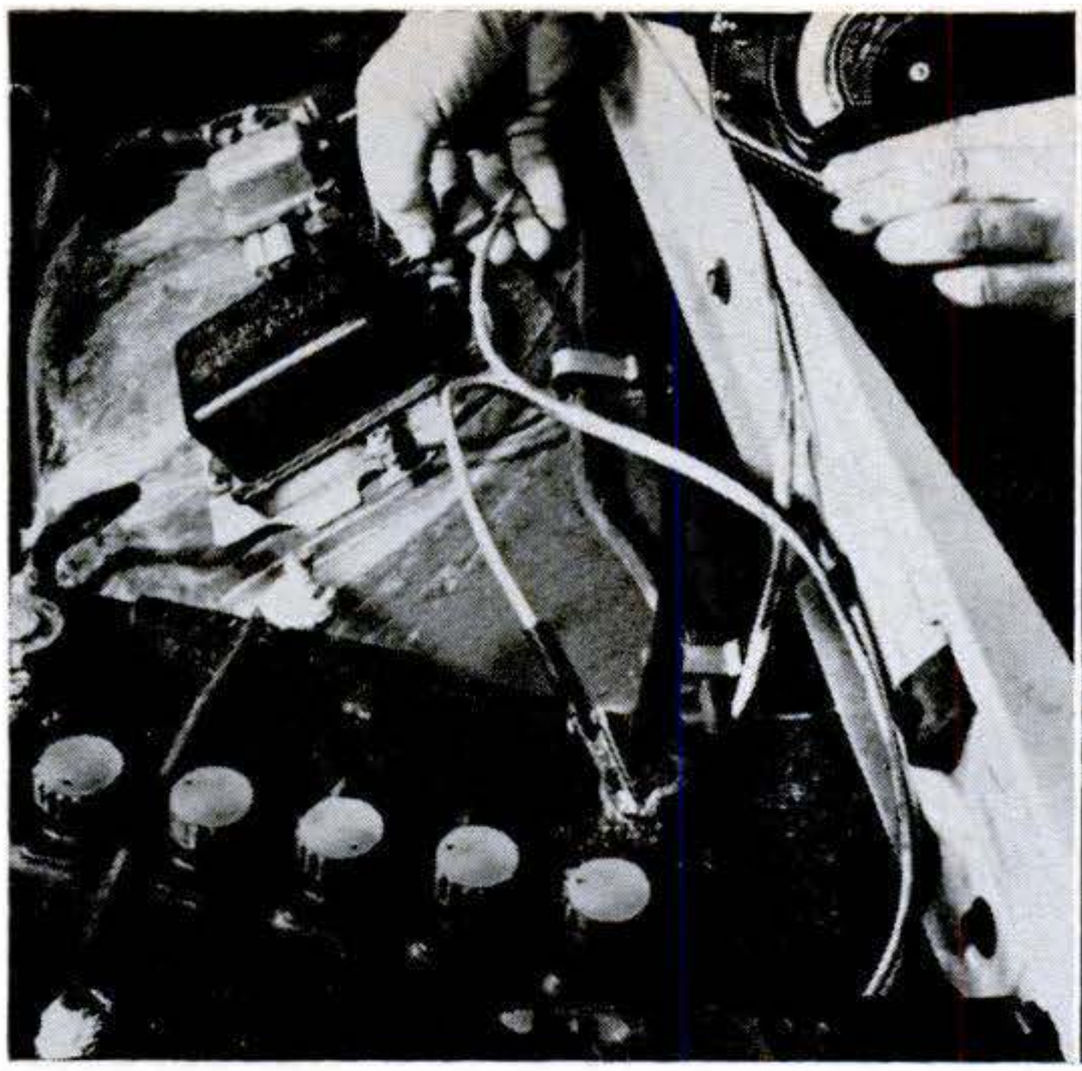
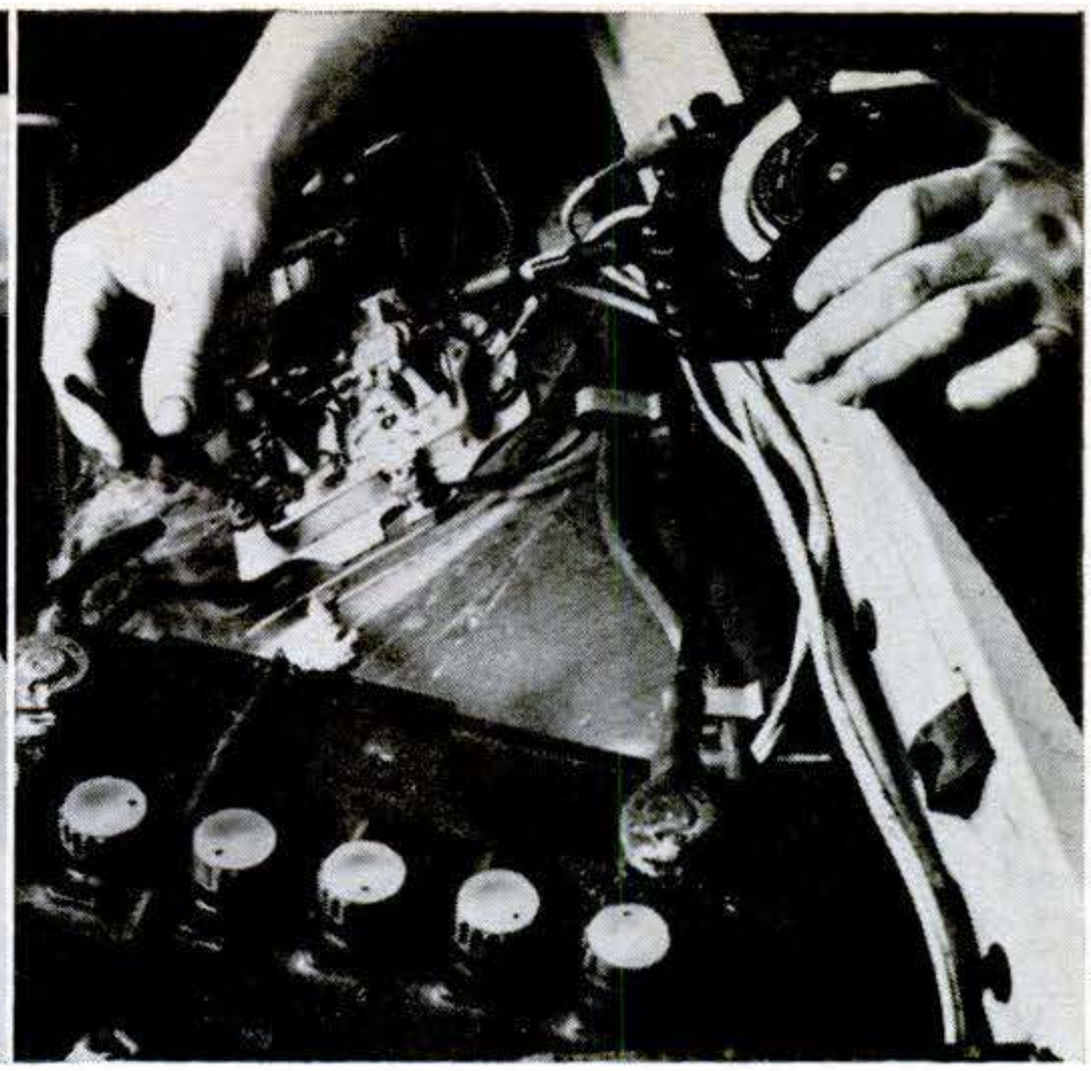
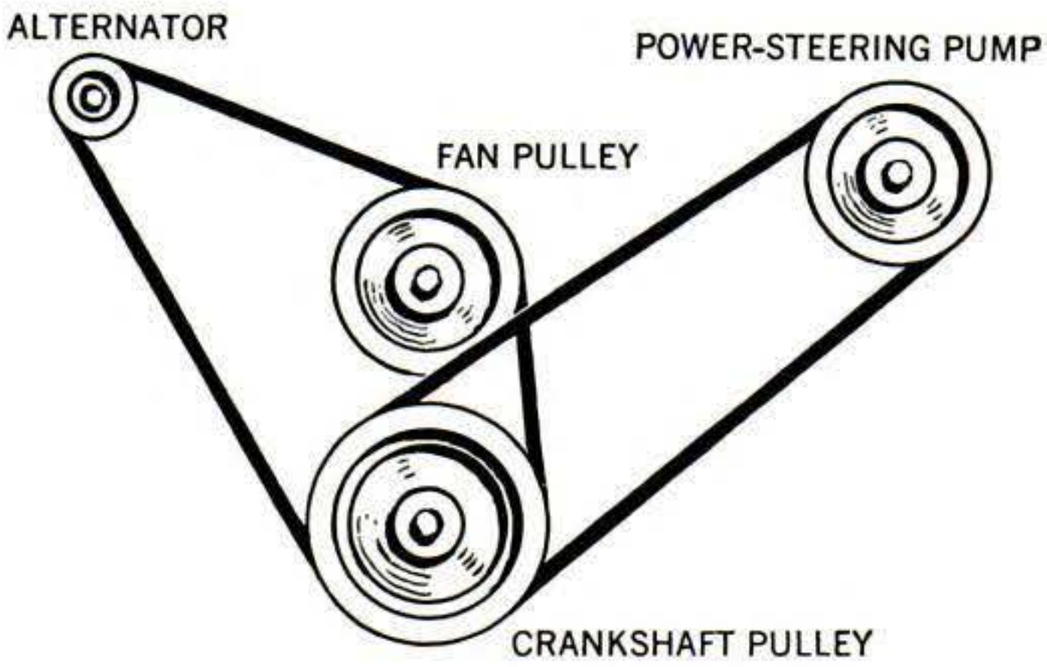


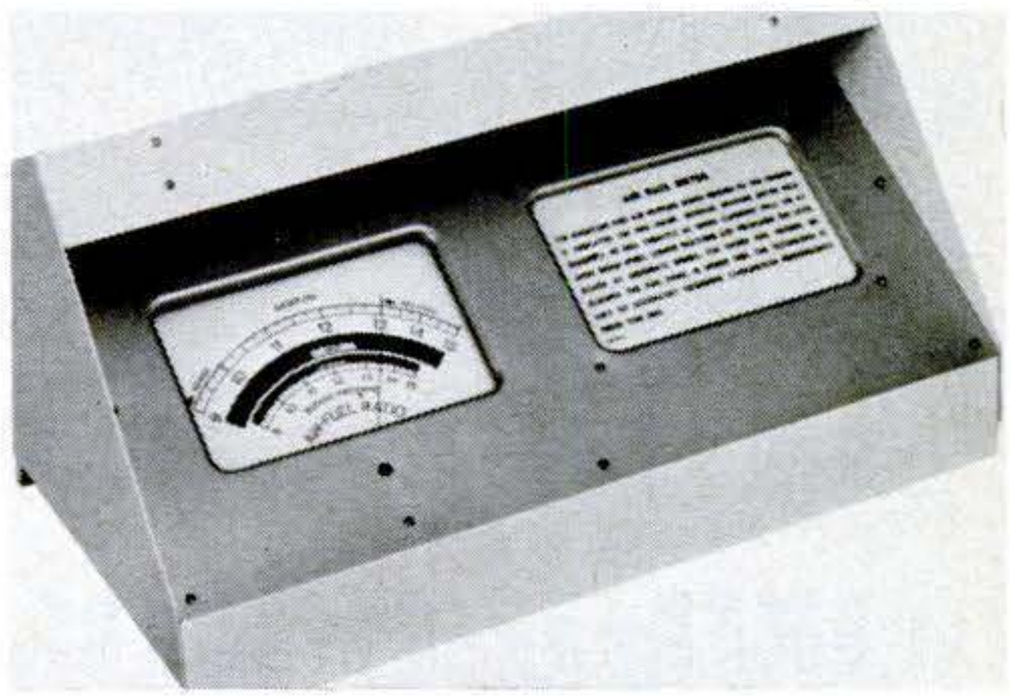
In case of a voltage drop from battery to regulator, use a DC voltmeter to check. A drop of 3/10 volt or greater in the reading indicates that your battery cables or terminals are undersized.



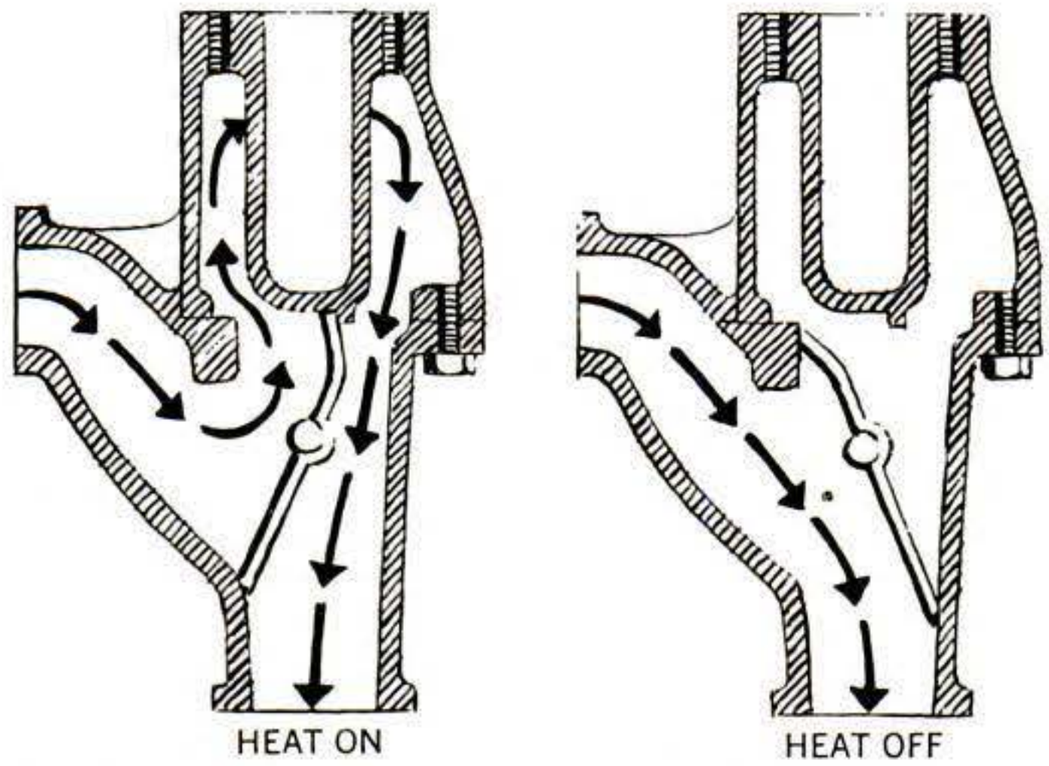
Adjusting the regulator may be necessary after other parts of the charging circuit have been checked. Raise or reduce the charging rate in steps of 1/10 volt until everything's exactly right.



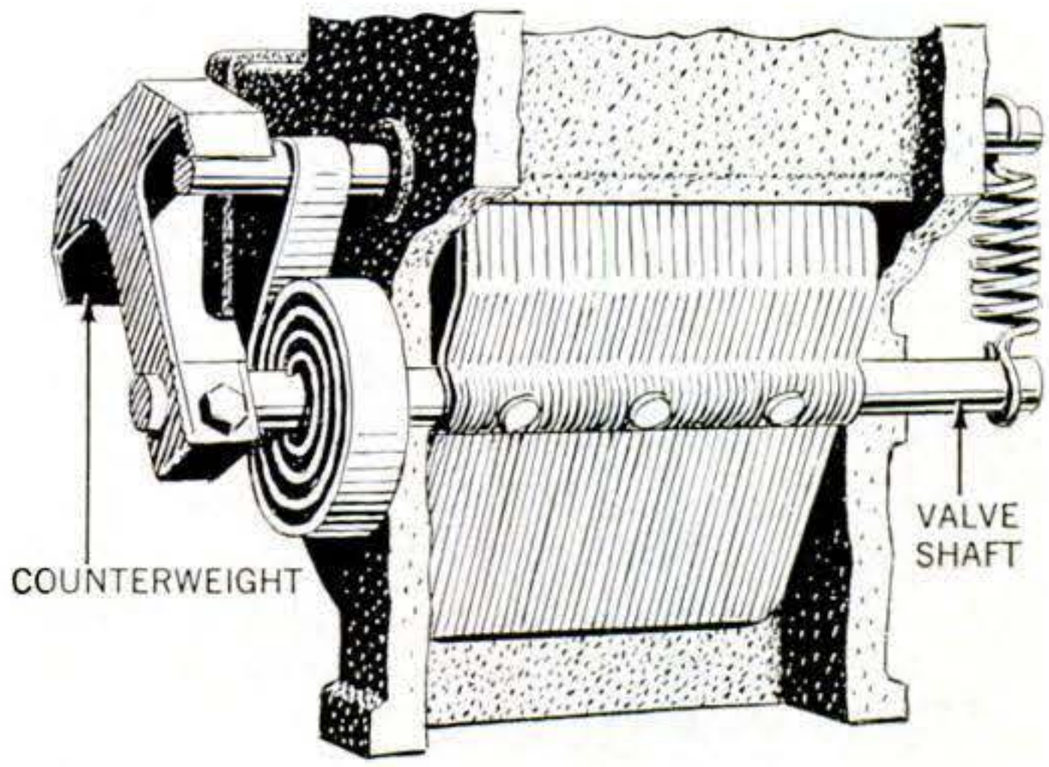
Inadequate battery charging in many cases can be traced to a slipping fan belt. Before starting a complete test, a good mechanic checks belt tension and makes the necessary adjustments.



Combustion efficiency is tested with an air/fuel meter, giving the ratio of air units per fuel unit. A good mechanic will make this test before he starts making carburetor adjustments.



Heat-riser valve, when it works properly, aids fuel distribution and prevents carburetor icing. If stuck in "on" position, it can cause spark-plug overheating, hard "hot" starts, and detonation.



To check the heat-riser valve during tune-up, move the counterweight to make sure that the shaft moves freely. If the shaft is stuck, apply a suitable solvent to loosen it when the manifold is cool.

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DuPont's nylon shutters are so easy to hang that you don't even need to use a ladder. Just nail the special spring-steel clip strips to the outside wall and snap the shutters in place. They are just as easy to remove when you want to paint the house.

Which HOUSE SHUTTERS...

By A. J. HAND

A few years ago house shutters were all made of the same material (wood), all needed maintenance, and all cost about the same. When you needed shutters, you just went out and bought them, painted them, and put them up.

Today shutters are made of aluminum and several plastics, as well as wood. Prices, durability, and construction details vary widely. And because shutters now are generally just ornamental, the louvers, except on some wood shutters, are fixed.

Plastic shutters. These are the newest on the market. New models are coming out all the time. Here are facts about a few:

- DuPont nylon shutters. These cost from $13 to $20 a pair, depending on size. They come in black, white, and green, but you can paint them if you like.
- Solid-vinyl shutters. As made by Bird & Son, E. Walpole, Mass., these cost from $11 to $14 a pair. They come in white, green, and gray. The vinyl itself is color-impregnated so they never need repainting, but you can, if you like, paint them to match your house.
- Fiberglass shutters. Van Horn Plastics, Des Moines, Iowa, has a unique approach to shutter construction. The fiberglass parts fit together—a top and a bottom rail, each 2″ wide, and center sections 15″, 20″, and 30″ long. You can snap the rails on the 15″ section and make a shutter 19″ long, attach them to the 20″ section and make a 24″ shutter. Or you can put center sections together—a 15-incher and a 20-incher with rails makes a 39″ shutter.

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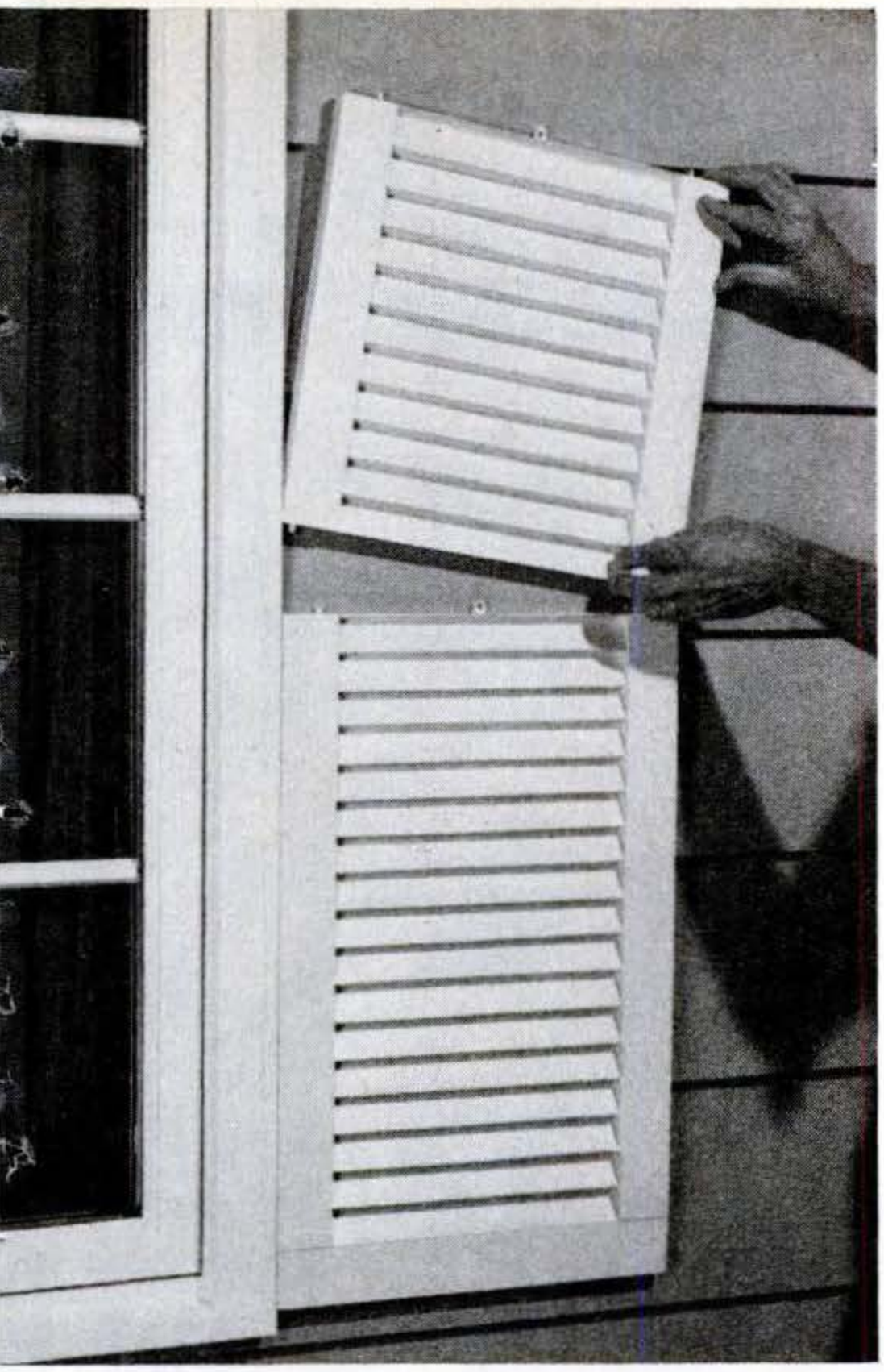
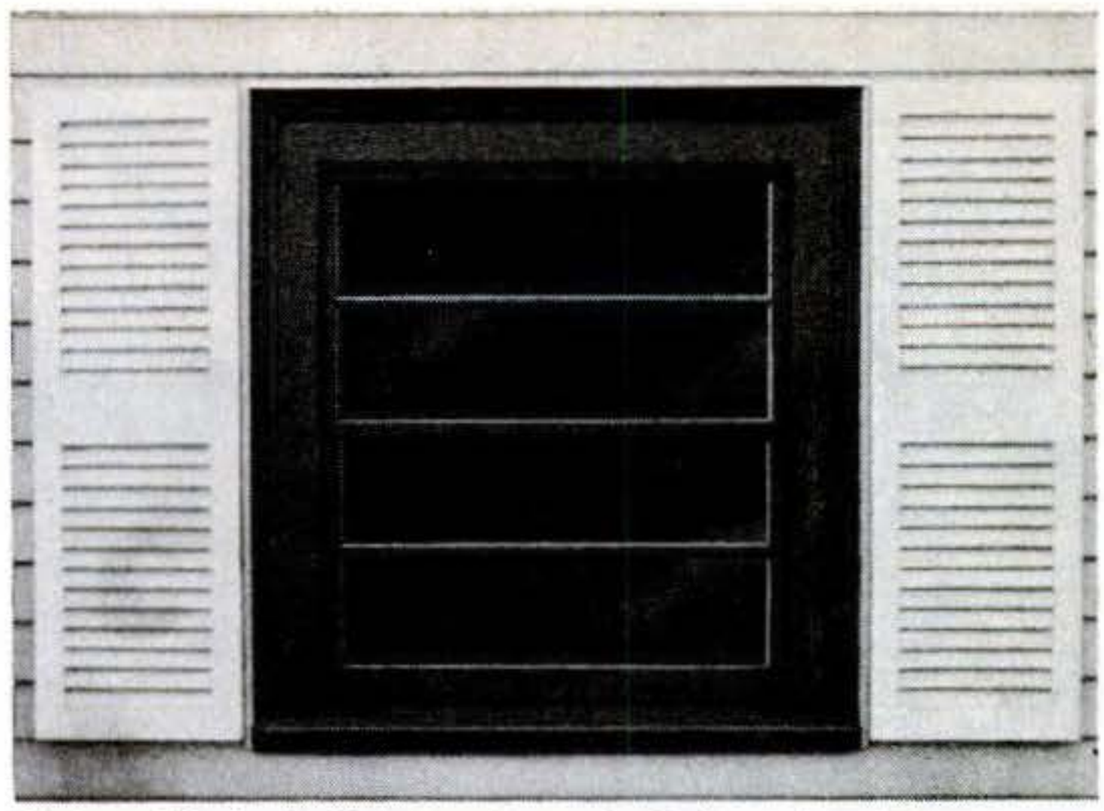
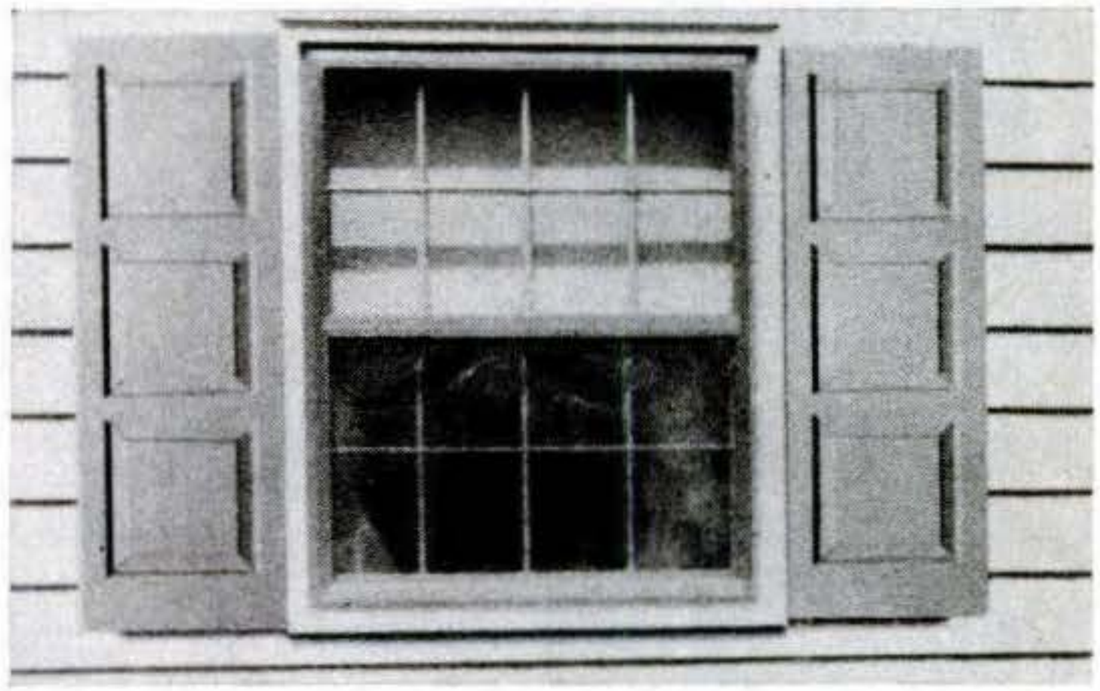


Van Horn fiberglass shutters consist of different-length center sections, and top and bottom caps. You snap them together to make any size shutter.



Bird solid-vinyl shutters have built-in color. They never require painting, won't rot, chip, peel, or blister. A wash with a hose cleans them in seconds.



Weathermate makes vinyl-coated styrene shutters in a full range of sizes. Shown here is the colonial raised-panel design, one of three types that are available.

wood, plastic, aluminum?

These brand-new shutters won't be available until after the first of the year. Prices are expected to be around $11 for a pair of 39″ shutters.

- Vinyl-coated styrene. Weathermate shutters by New Castle Products, New Castle, Ind., have a wood-grained texture and come in white, gray, and green. They are made in three styles, louvered with or without a crossrail, and a raised-panel model. They cost about $9 for a pair of 39 inchers in the 14″ width.
- Plastic on wood frame. Leslie Welding Co., Franklin Park, Ill., uses plastic backed by a wood frame. The shutters come in green, black, and white, and range from $8.50 to $20 a pair. A self-sticking crossrail you can position anywhere along the shutter's length costs 56 cents a pair.

Aluminum shutters. These cost from $10 to $20, depending on size. They're easy to maintain, and come primed and ready to paint, or factory-finished. Alcoa makes them in six colors—black, white, gray, maroon, and two greens; Reynolds' come in black, white, and two greens.

Wooden shutters. The cheapest shutters, in terms of initial investment, are wood. They range, unprimed, from about $5.50 a pair for a small 14″-by-25″ size to about $11 for a pair 16″ by 70″. Primed shutters, ready for a finish coat, are about 50 cents more.

Wood shutters must be painted every few years (a fairly easy job with a spray gun) and occasionally need complete refinishing. Maintenance required varies with climate. They're usually mounted with hinges, so they can be closed, or swung out of the way for house painting.

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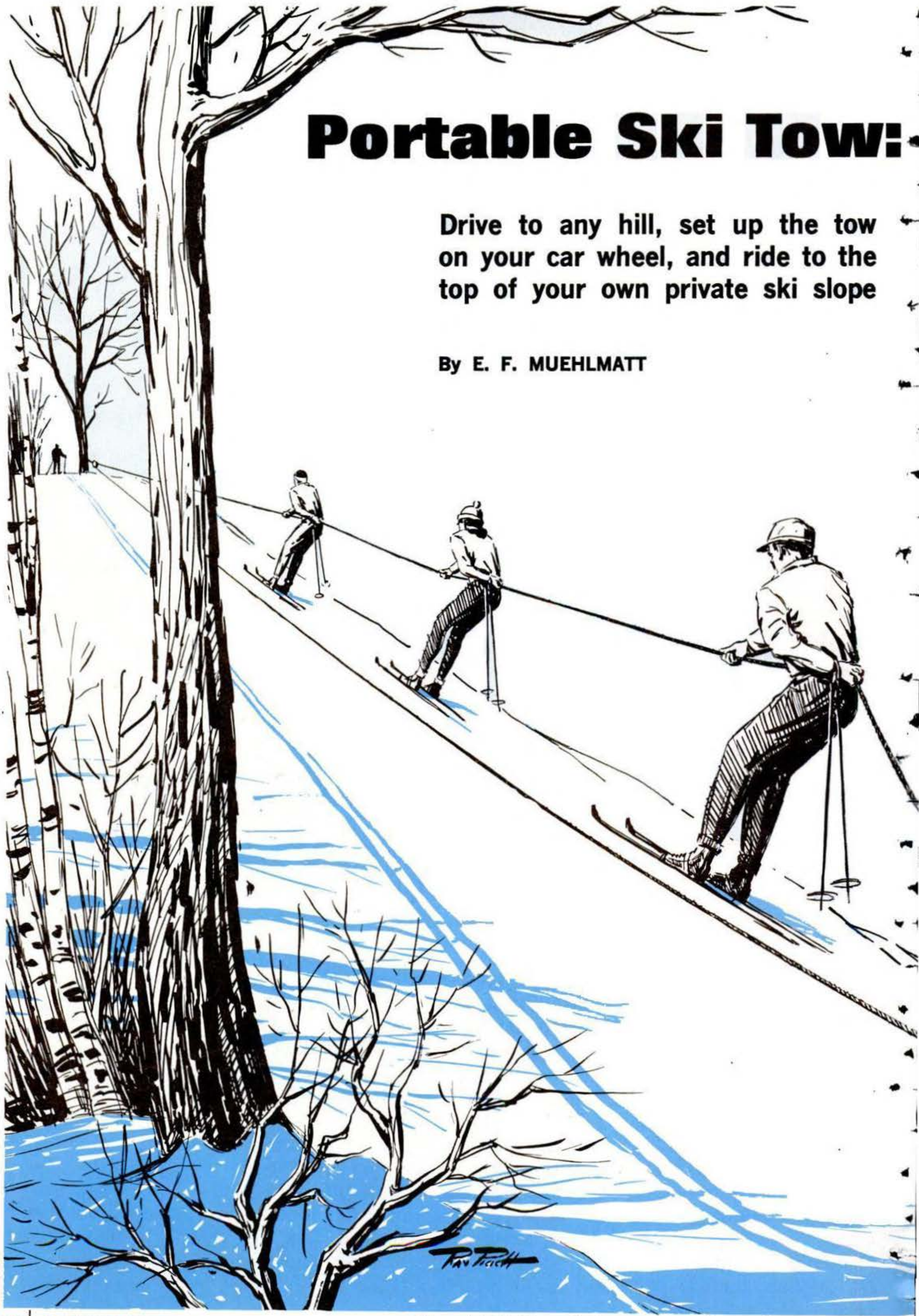
Portable Ski Tow:

Drive to any hill, set up the tow on your car wheel, and ride to the top of your own private ski slope

By E. F. MUEHLMATT



Now! PS lies flat on your bench or table . .

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Easy to Make, Fun to Use

Ever stand in a long line wasting precious minutes waiting to get on a ski tow? Or wish for a slope all to yourself? With this portable rope tow, you can turn almost any steep slope into a private ski area. It sets up in 15 minutes.

A rear wheel of your car drives the tow. You can park the car at either the top or the bottom of the run (where, incidentally, the car provides a convenient warming shelter, too).

The tow costs about $20 to make if you already have the rope; about $90 if you don't. Even at the top price, it won't cost you much more than you'd spend during the season on a couple of ski trips. And

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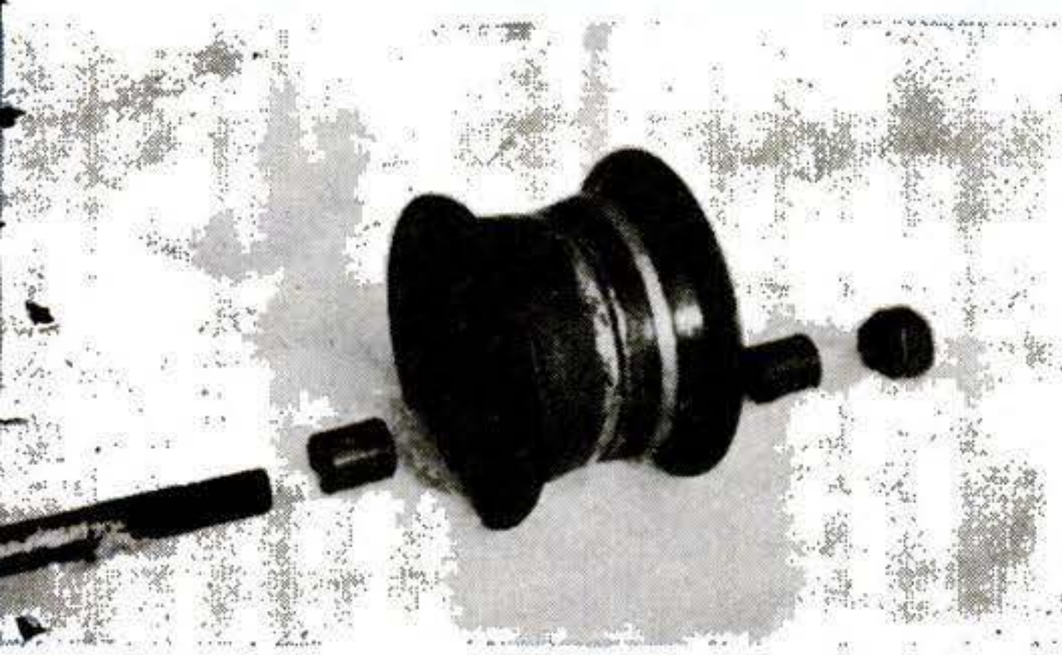
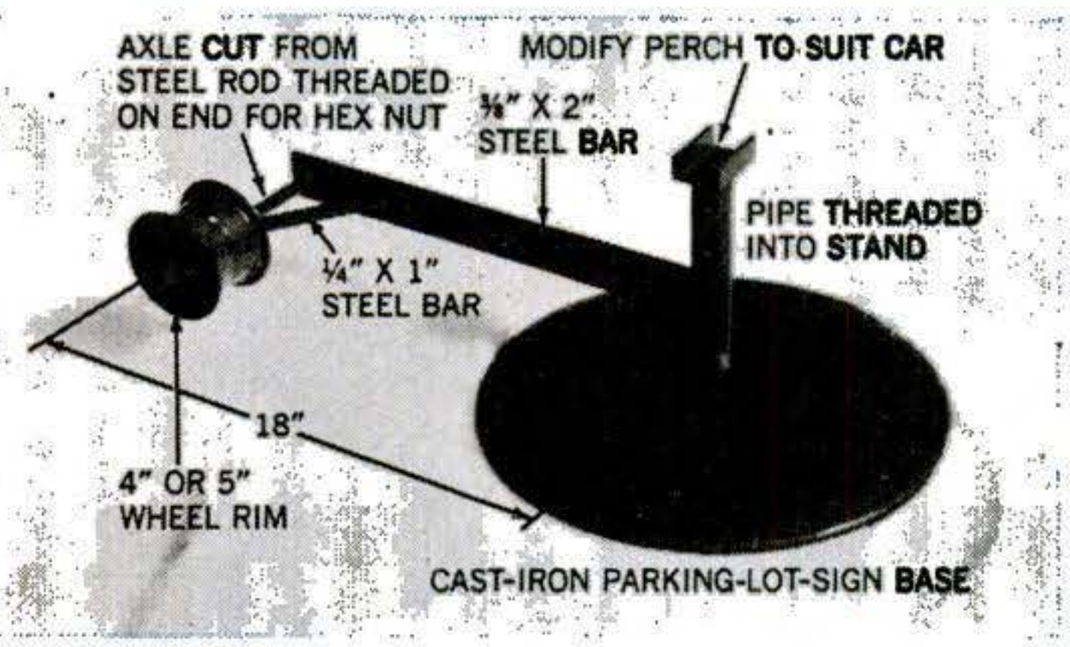
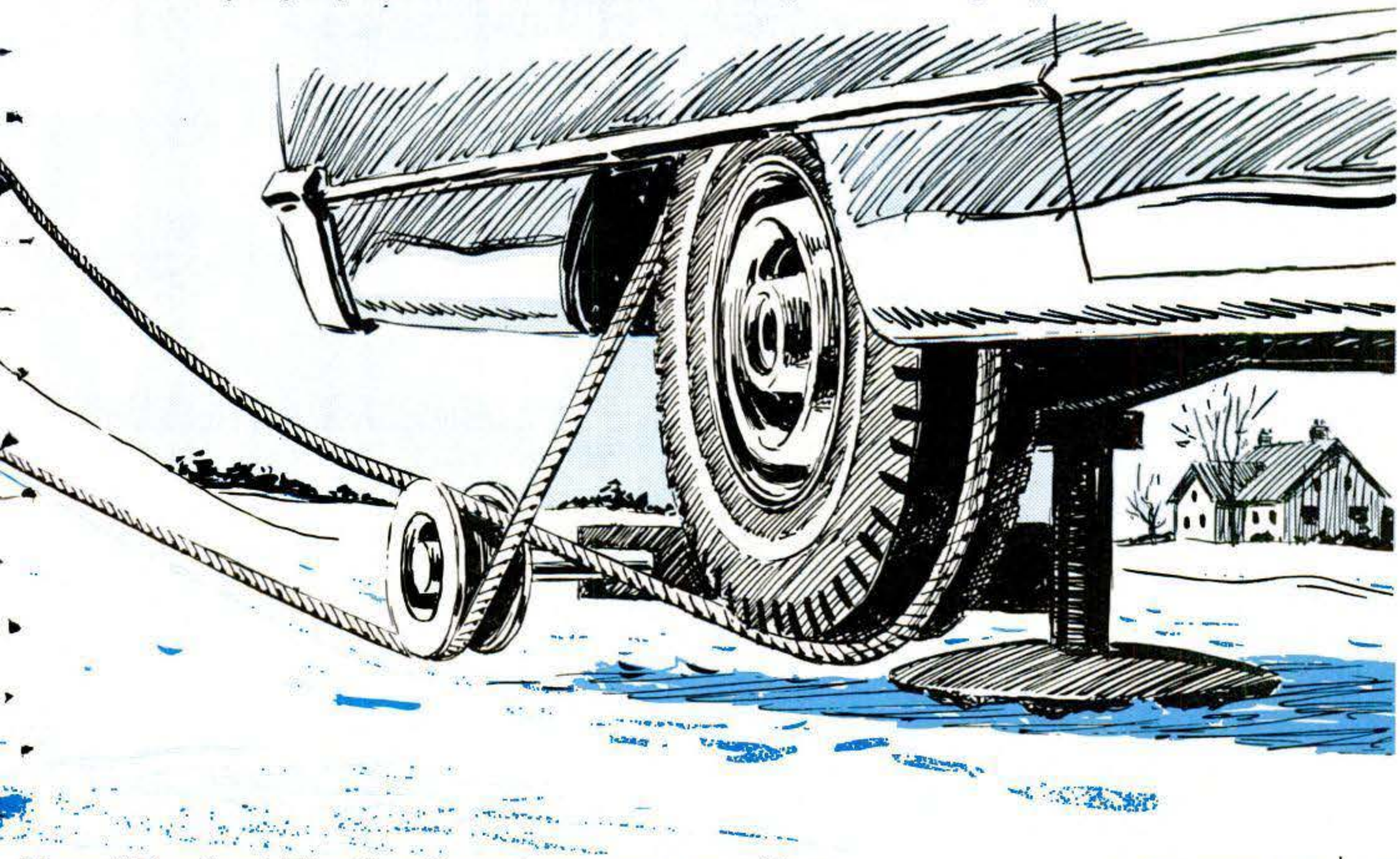


Cut spacers from pipe, and slip them on the axle to hold the guide pulley in the proper position relative to the drive tire. A hex nut threaded onto the end of the axle holds the pulley in place.



Completed tow consists of a stand to hold the drive tire off the ground and a pulley to hold the tow rope on the tire. You can make the tow yourself or have it made for you at a welding shop.



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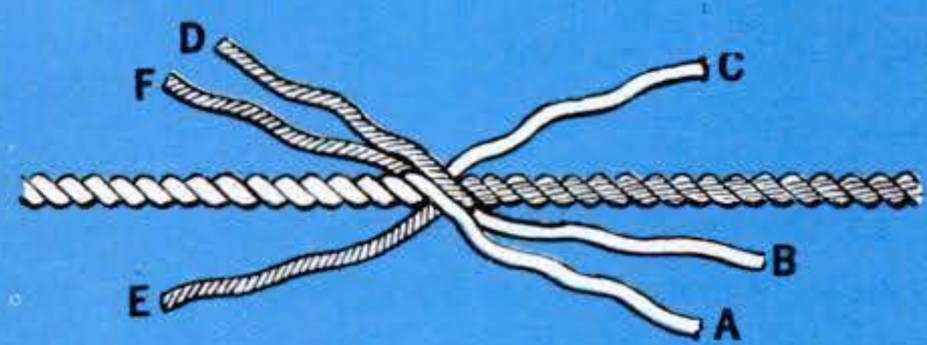
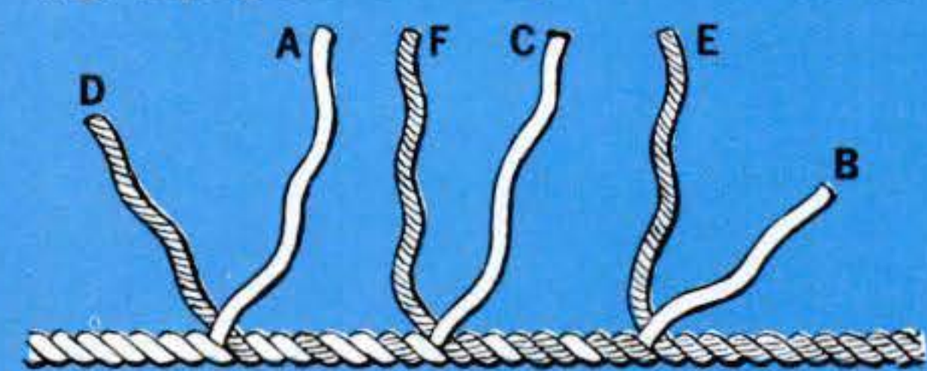
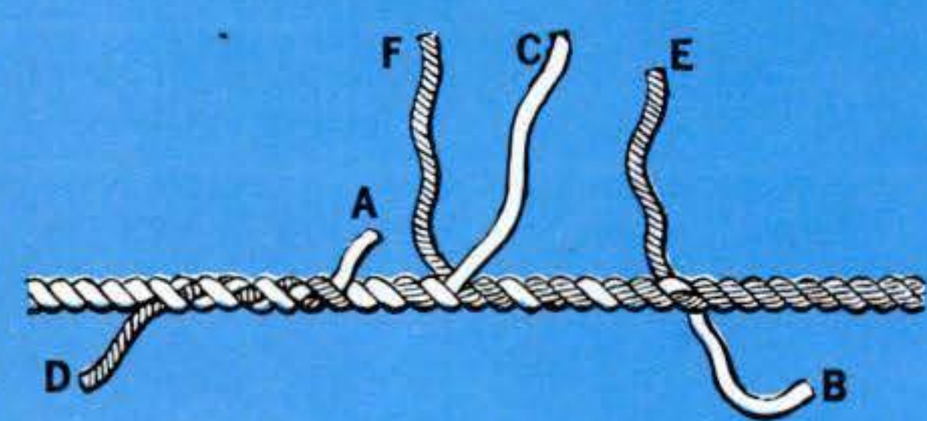
A long splice joins the two ends of the tow rope to form a continuous circle



1 Unlay the ends of the rope about 15 turns and place them together as shown, with the opened strands from each end crossing. Taping strand ends prevents unraveling.



2 Starting with any opposite pair, unlay further one of the strands and wind the other in its place. Then repeat in the opposite direction with another pair of strands.



3 Tie each pair of opposing strands with an overhand knot (E+B), and tuck under each strand four times (A+D). Roll and pound splice; cut off strands close to rope.

you'll save money that used to be spent on ski-lift tickets.

You'll need a continuous piece of ¾″ rope about 600′ long to loop around the rear tire of the car, a stand to hold the tire off the ground, and two pulleys.

The design is simple. One pulley, mounted on the stand, is made from a small wheel rim from a go-kart or riding mower. It holds the rope on the drive wheel. The other pulley—a standard block for 1″ rope—goes at the opposite end of the rope loop.

You may have to change some of the dimensions in the drawing to suit your car. The guide pulley should keep the rope traveling on center on the tire. To keep the pulley lined up, use spacers made from pipe. The length of the 2″ steel-bar side arm should be adjusted to position the pulley about 3″ behind the drive tire. This will hold the rope in contact with almost two-thirds of the circumference of the tire to give good traction.

I used the base from a parking-lot sign as the base for the tow. If you can't find one, use a 16″-by-16″ square of ⅛″ steel, and weld the 1½″ pipe to it. Before you leave home, join the ends of the rope with a long splice, with the pulley in place. This splice will not increase the diameter of the rope, thus allowing it to run freely through the pulley. The drawings at left show how to make the splice.

Setting up the tow. Jack up a rear tire of the car on a level stretch of ground at the top or the bottom of the hill—whichever is convenient. With the tire up, set the stand under the axle or suspension, align the guide pulley with the center of the tire, and lower the car onto the stand. Lay out the rope to its full length, loop it around the tire, and cross it between the pulley and the tire. Then stretch the rope tight and fasten the pulley at the other end of the looped rope to a stake or tree. Keep the pulley about 2′ off the ground to keep it from clogging up with ice.

Turn the rope over by hand to make sure it hasn't frozen to the snow. Then start the wheel spinning slowly. The rope will ride to the highest part of the tire and stay there. About five m.p.h. is a good speed. Do not accelerate too quickly or the rope may skid on the tire and slip off. This will happen, too, if the tow is overloaded.

If you like, you can use an old tire on a spare wheel for the drive. Cut a ⅝″-wide groove about ⅜″ deep into the center of the tread. It will keep the rope from slipping off the tire even under heavy loads.

A setup like this is capable of pulling well over 15 people up the slope at one time. The same tow powered by a seven-hp. garden tractor will tow seven or eight people at about six m.p.h.

Don't be tempted to use rope any thinner than ¾″. It may be strong enough to handle the job, but it will be hard to grip without tiring, especially when you have mittens on. Three-quarter-inch rope costs about 12 cents a foot. PS

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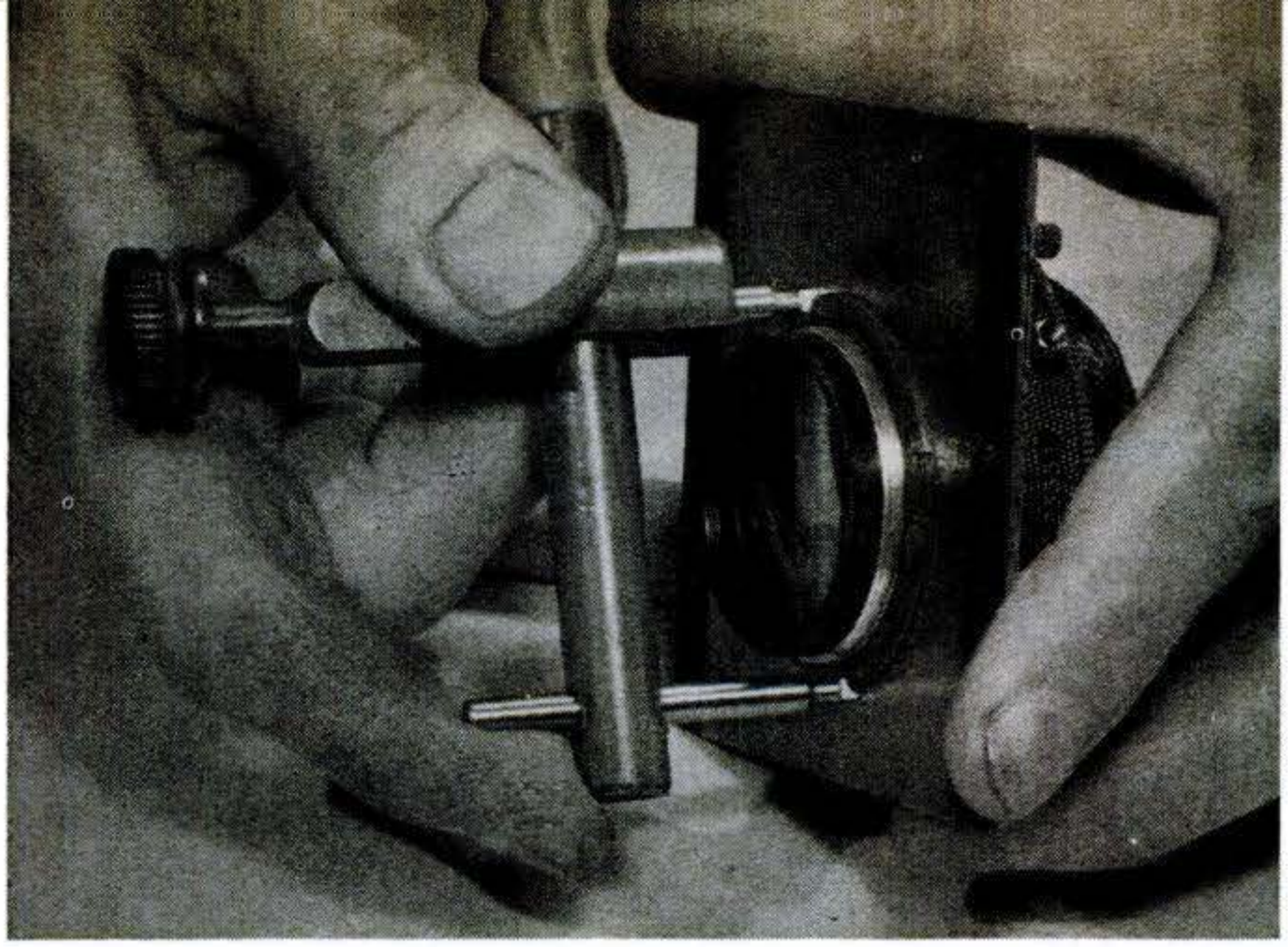


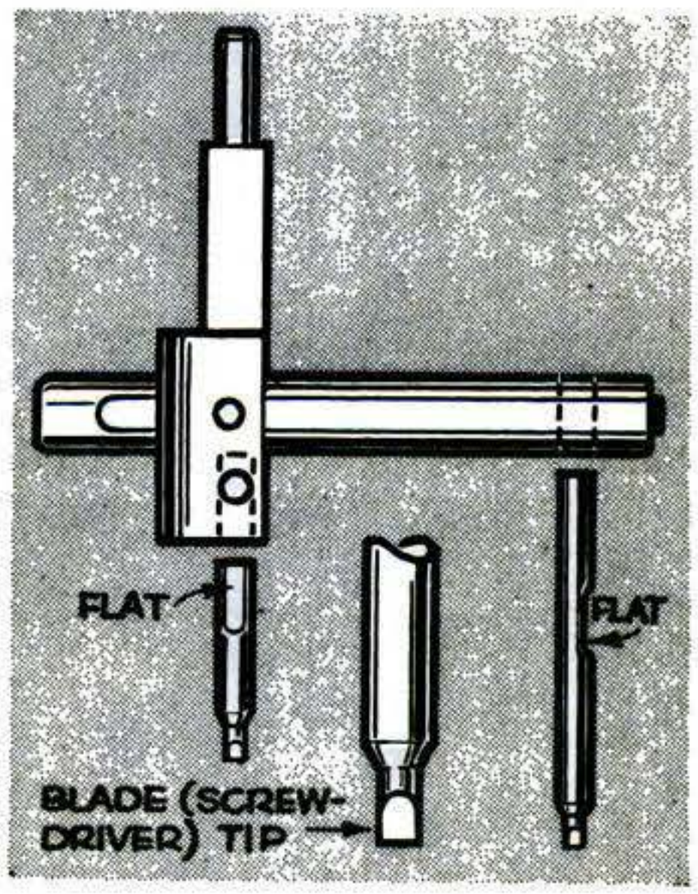
PS METALWORKING

Short Cuts for Machinists

Make your own adjustable spanner wrench

An inexpensive circle cutter (less than $1) converts into an adjustable spanner wrench for the retaining rings used on lenses and instruments. You simply make two screwdriver-like fingers to take the place of the pilot drill and bit of the circle cutter. Take two pieces of drill rod that fit the drill and cutter holes, and turn down the ends as shown in the drawing at right. File screwdriver flats to fit the retaining-ring slots. Also file setscrew flats so that the two "screwdrivers" align. Harden and temper the drill rod.

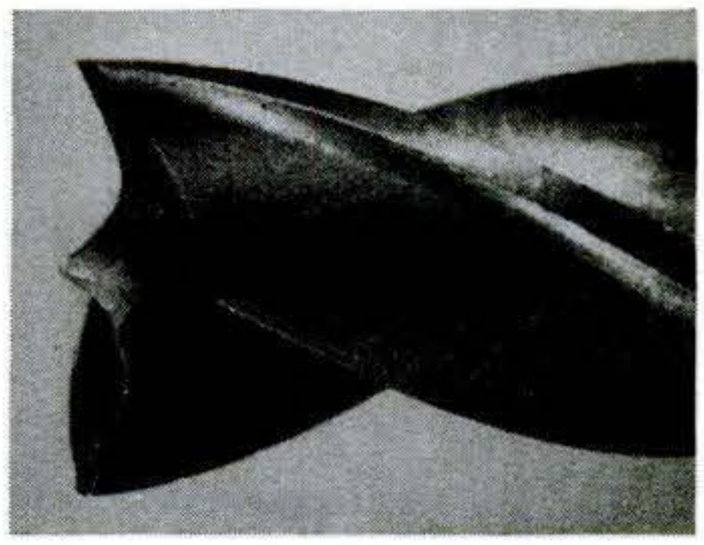
WALTER E. BURTON, Akron, Ohio.



Reground drill makes hole cutter for thin metal

Grind the tip of a drill (a broken drill is fine) as shown in the photo at right, and it cuts clean holes in thin sheet metal. A center-punched hole guides the tip of the drill; the pointed flutes cut through the circumference. This works particularly well with large-diameter drills, and takes the place of hole cutters that you buy. The drill doesn't grab the stock and whirl it around dangerously.

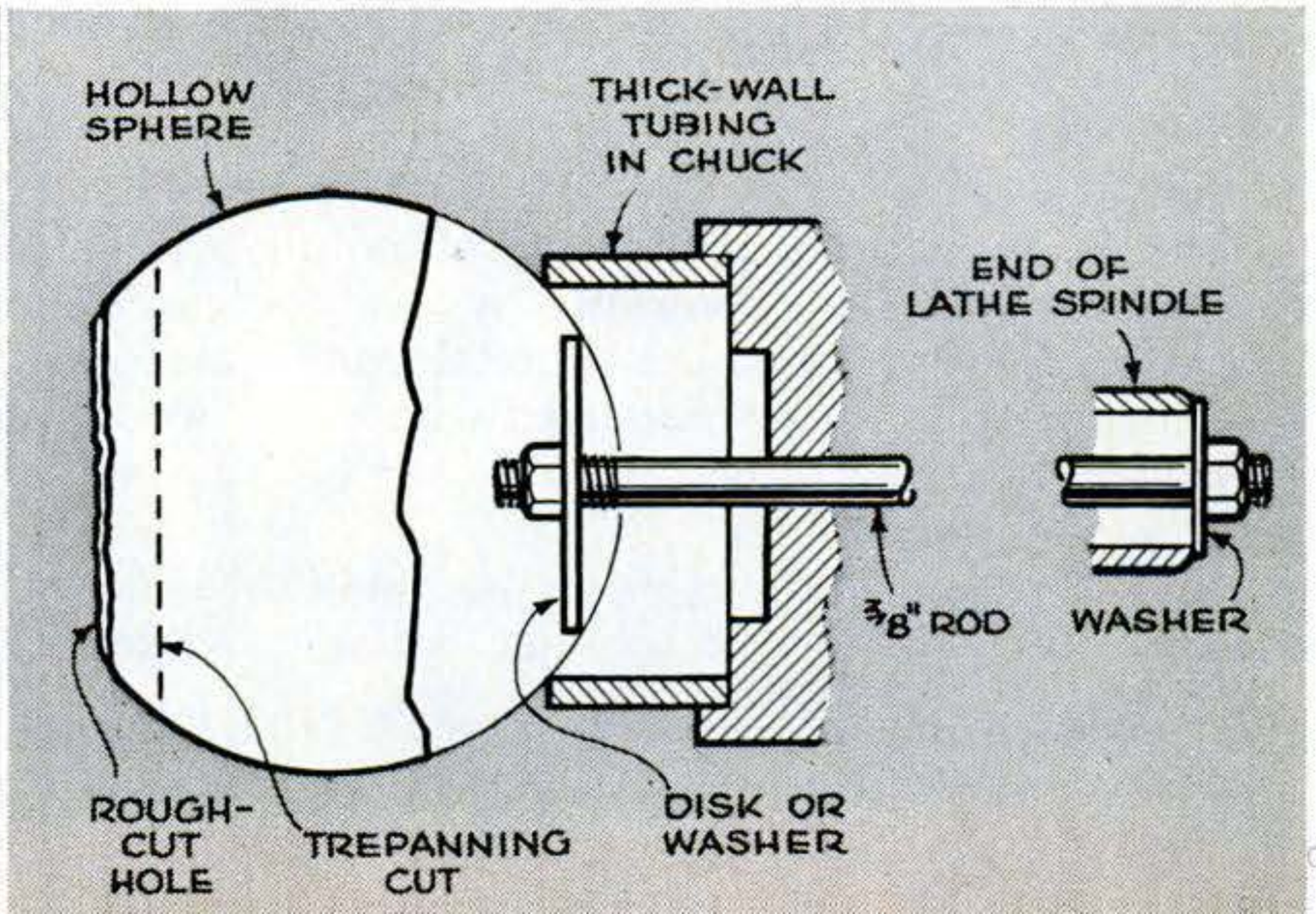
H. F. WENNERSTROM, Eau Claire, Wis.



How to chuck a hollow sphere

Here's how I solved the problem of securing a hollow sphere for turning. I chucked a thick-wall ring (plastic tubing in this case) in the lathe, bored it true a short way in from the edge. I then cut a rough hole in the sphere (a brass toilet float) and drilled a small one opposite it. I seated the sphere in the ring and drew it tight with a threaded rod run through the lathe spindle and attached to a disk inside the sphere. The sphere then ran true for turning. The cut was made with a sharp tool and light feed.

HARRY WALTON, White Plains, N.Y.



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To find the final color of a stain, apply the first coat of the finish; it also affects color. Above at left, a walnut water stain was diluted 1:1, 1:2, 1:4, and 1:8 on a sample of wood. The real color shows where the topcoat (varnish) has been applied.

BEST FINISHES FOR WOOD:

How to Use Stains to Get

Simple materials and easy techniques are all you need to bring out the beauty of wood

You can be sure that the color of most finished wood has been controlled by means of a stain. In some cases, the entire character of the wood may have changed. In others, perhaps only a hint of color was added to make a good wood better.

Staining is easy to do. New methods and materials eliminate uneven coloring, fading, overstaining, bleeding, and other old-time bugaboos. The normal application is simple – brush on, wait a few minutes, wipe off.

Although any good stain will do almost any staining job, certain varieties are best for certain jobs.

Pigmented wiping stains. The prototype material in this classification is Minwax. Identical stains are made by virtually every paint manufacturer, with names like "oil stain," "wood finish," "wood stain." These consist of a penetrating-resin vehicle in which pigments have been stirred.

The pigments are not in solution, but in suspension. The stain must be stirred con-

Now! PS lies flat on your bench or table .

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You can mix your own pigment stains. Use universal pigments in an oil base or, for quick drying, in a brushing lacquer. Swatches on maple (left) are burnt sienna, with increasing amounts of lampblack.

Not all stains give you the true tones of wood. Many decorative effects on plywood and other paneling result from such colors as green, blue, and red. Several stains for this specific purpose are available. Use them as brush-and-dry products or as wiping stains as shown in the photo above.

the Color You Want By JACKSON HAND

stantly to maintain a uniform color. Some color may come from dyes dissolved in the liquid, but the major color results from the pigments.

New additions to this family of stains include one in a water emulsion (Deft) and another that comes in a tube – toothpaste thick – and is perhaps the easiest of all stains to use (Even-Even).

On the wood, the wiping stains tend to leave the most pigment in pores, in softwood areas, in blemishes. This means that they accentuate grain pattern, as well as any places not smoothly sanded. Soft and porous woods such as pecan, lauan, and fir accept a great deal of stain, darkening heavily. Harder woods such as maple, birch, and beech take less stain. Walnut and mahogany darken mostly because of pigment deposited in the pores.

Although pigmented wiping stains come in all the regular wood-tone colors (plus more) and are regularly used on all woods, they perform best on pine and other softwoods. Owing to the way cracks, dents, and scratches catch the pigment, wiping stains are the best for any "distressed" finish, as well as for furniture and paneling in the "primitive" style now growing in popularity.

Continued

. . New "Perfect Binding" makes easy reading

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Here, in color, are the reasons why you should stain wood

Application of pigmented wiping stains is simple enough to be covered well on all can labels. Stirring is vital. Full flow of the material to all areas is vital. Clean wiping after penetration is vital – to prevent pigments from obscuring the grain.

Color control is simple. Longer penetration means darker colors. Wipe sooner or thin with turpentine for lighter colors. Alter the hue with all-purpose pigments, if you want to, in all except Even-Even, which is difficult to doctor.

Pigmented wiping stains in a penetrating resin do more than stain. They seal, to a degree. For that reason on paneling or other noncritical areas you can complete them with a topcoating of wax or a single coat of varnish or shellac. For high-abuse areas, you need only two coats of varnish compared with the three-coat system usually recommended. Water-based pigmented wiping stains and Even-Even require start-from-scratch finishing schedules, since they provide less sealing effect.

It is common for wood finishers to make their own pigmented stains. For a base, you can use any of the penetrating-resin finishes (Rez, Val-Oil, Firzite, Watco, DuPont Penetrating Wood Finish, etc.). Blend in colors to produce the shade you want, using colors-in-oil or the universal tinting pigments now becoming more prominent.

You can come close to almost any wood hue with four basic colors – burnt umber, burnt sienna, Vandyke brown, and black. Add to this list a tube of red, yellow, and blue. These primary colors are used to produce slight changes in the wood tones, to make perfect matches or to produce the exact color you want. With a little experimentation you will learn how much you have to add.

True stains. These are aniline dyes dissolved in a liquid. The dyes stain the wood fibers. To the degree that softer grain will absorb more than harder areas, a true stain increases the contrast and the character of wood. This is far more subtle than with pigmented wiping stains, however. Since there are no oils or resins in the material, it dries flat and dull and you can't know the final color until you experiment with the stain plus at least one coat of the protective material you plan to use. These stains provide no protection, and must be coated with varnish, shellac, or lacquer – or with a penetrating-resin finish as used on bare wood.

There are two kinds of true stains in common use, and they differ enough to be discussed separately.

Water stains. The liquid is water. The color is aniline dye in powder form, usually blended by a dye house, put up in one-ounce packets and labeled with wood names such as "brown mahogany" and colors such as black, green, and red. You dissolve a packet of dye powder in a quart of boiling water. This forms a stock solution that you may use straight, dilute with water for lighter shades, or modify with other water stains. Not all paint and hardware stores stock these powders, but they can order them. Or you can order from such supply houses as Albert Constantine & Son, 2050 Eastchester Road, New York 6, N.Y.

There is much variation in stain colors from one line to another. A packet labeled "walnut" may be three different colors from three different manufacturers. For this reason you may have to experiment to find

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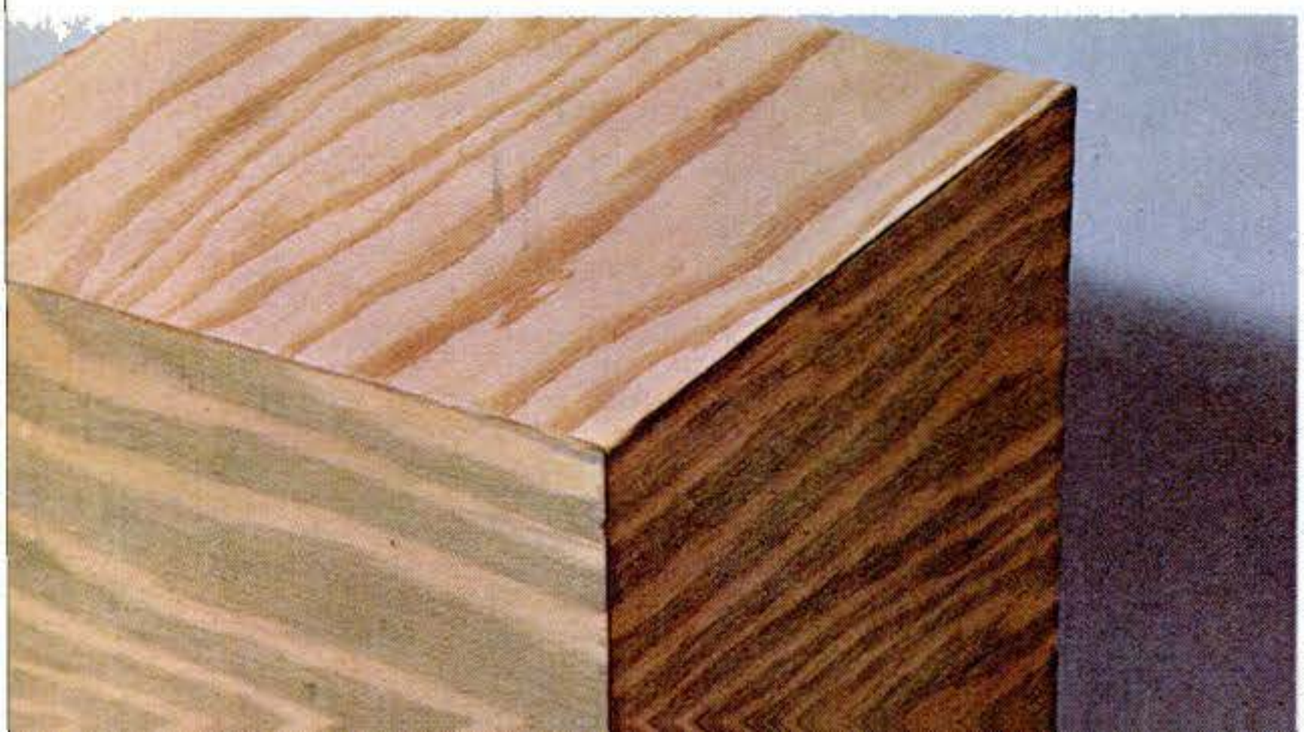
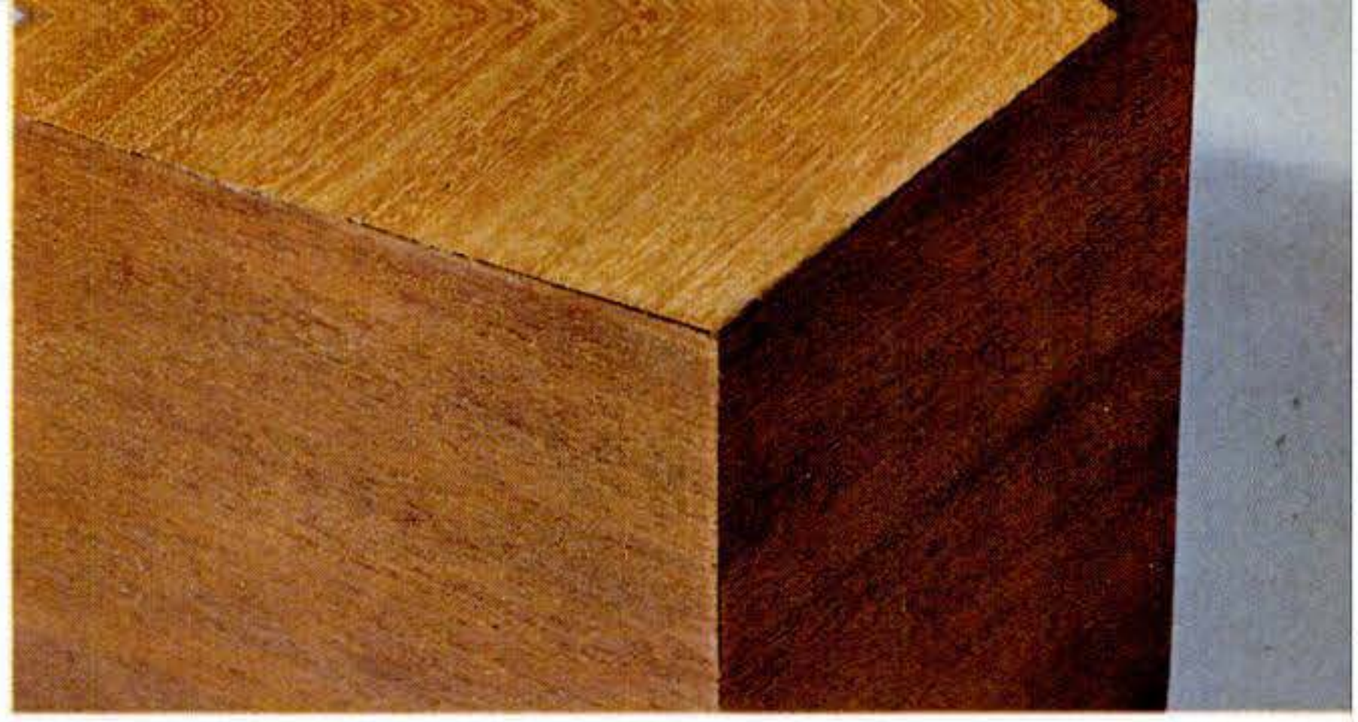
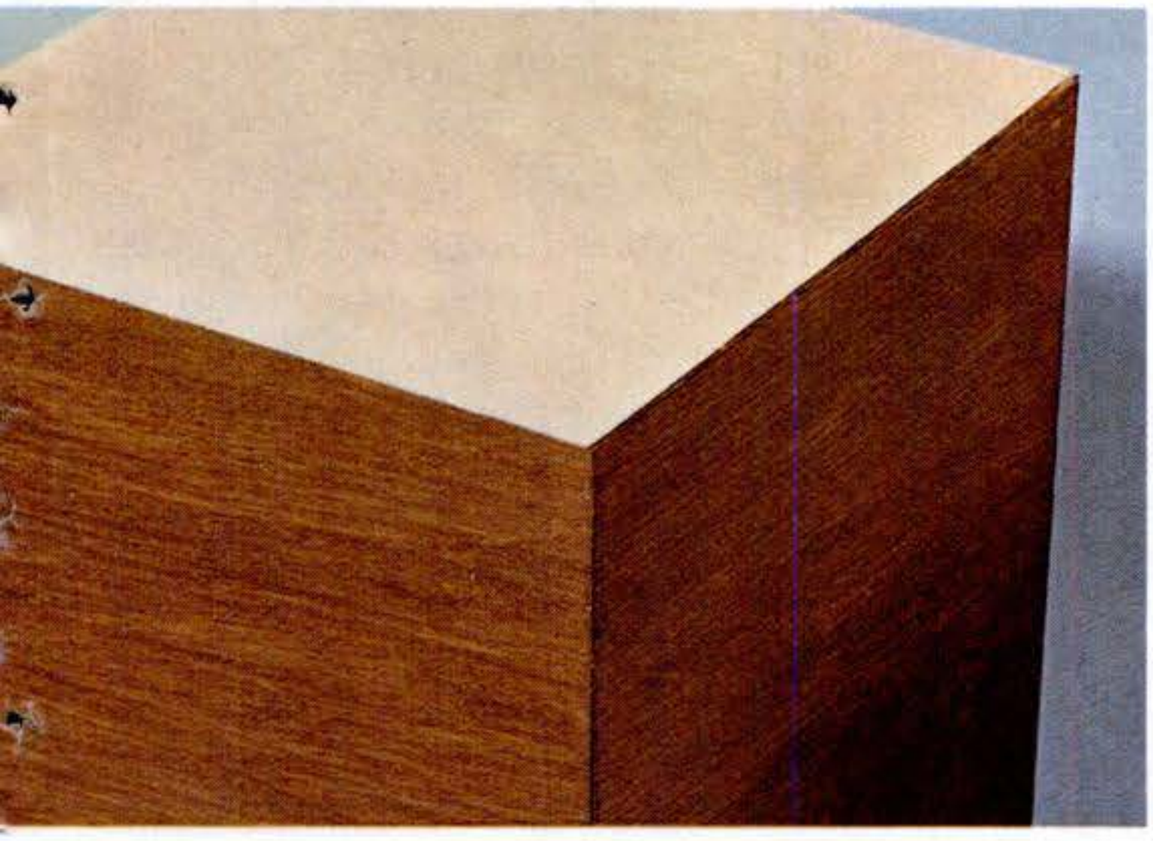
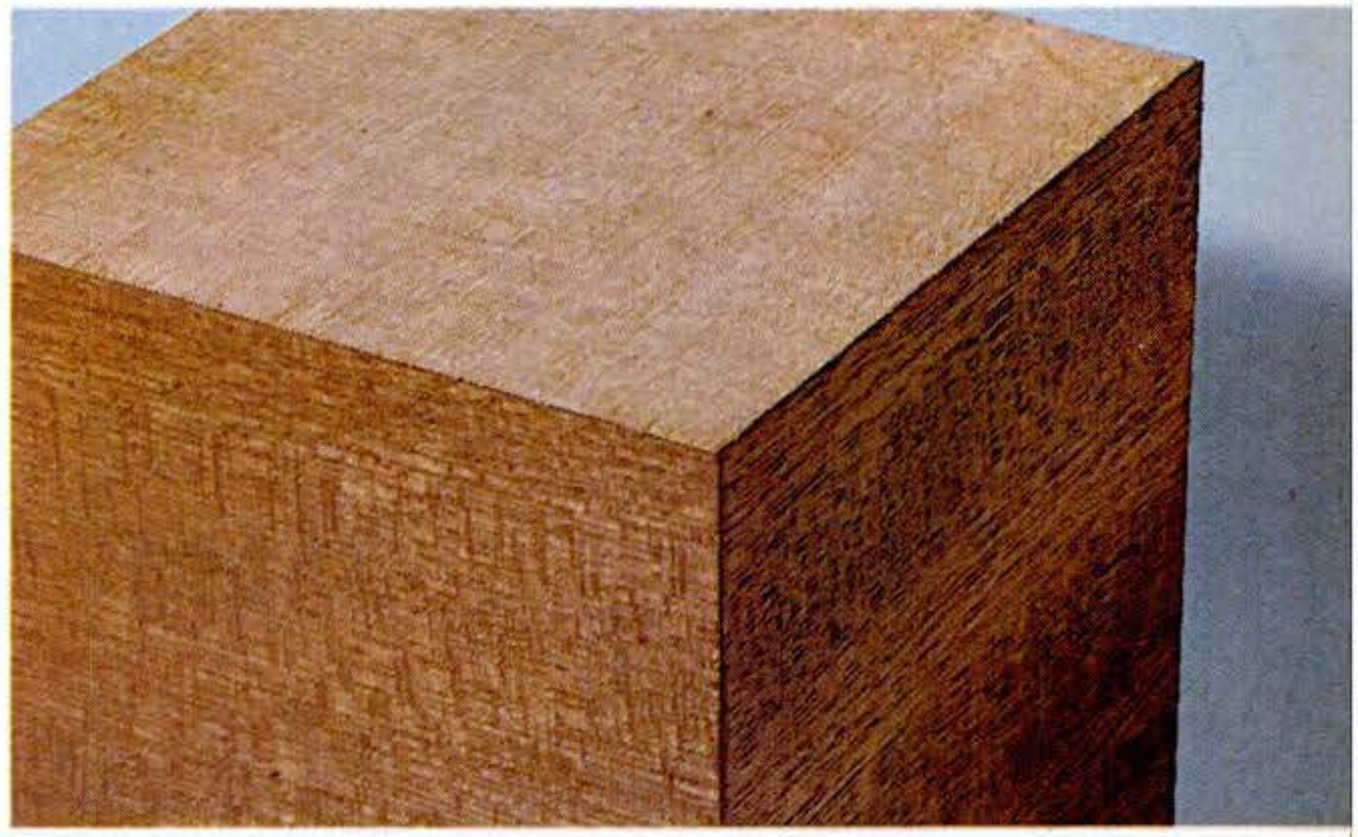
You can get a color tint not found in natural wood. In these samples, fir plywood was stained with regular enamel, thinned slightly and handled as a wiping stain. Grain accentuation is remarkable.



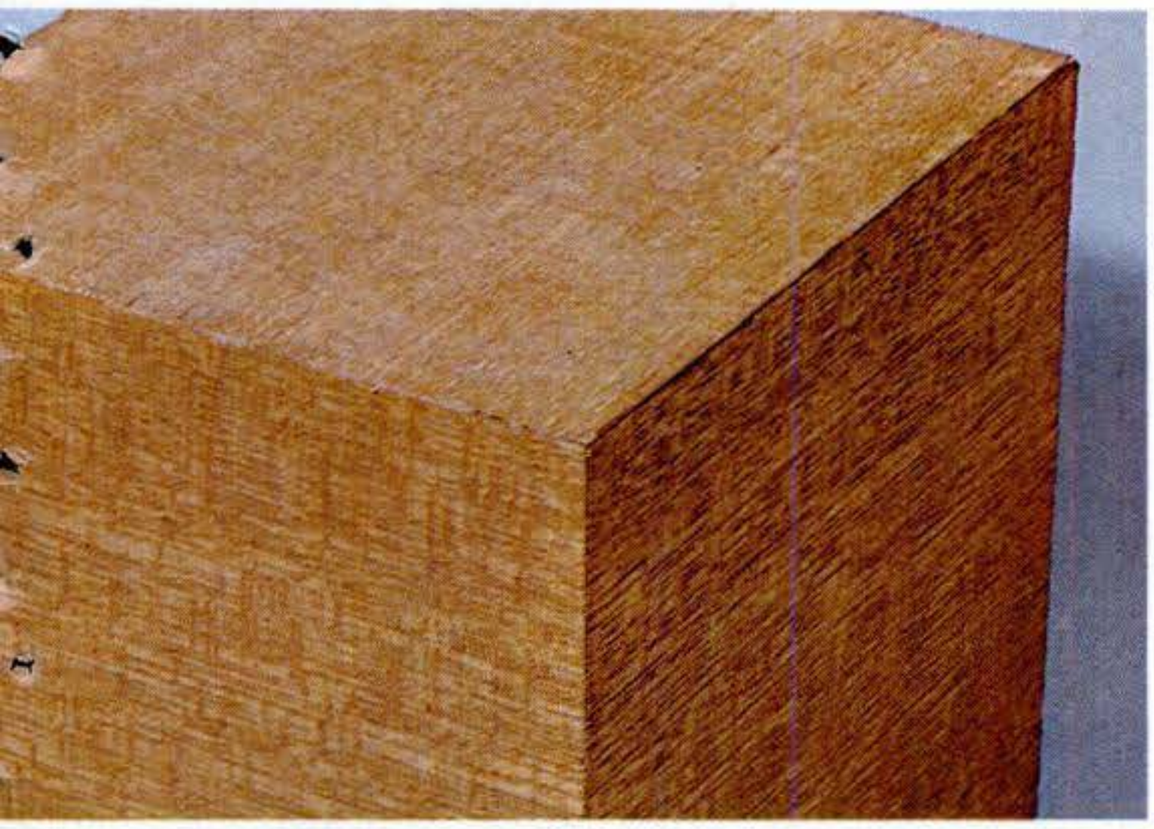


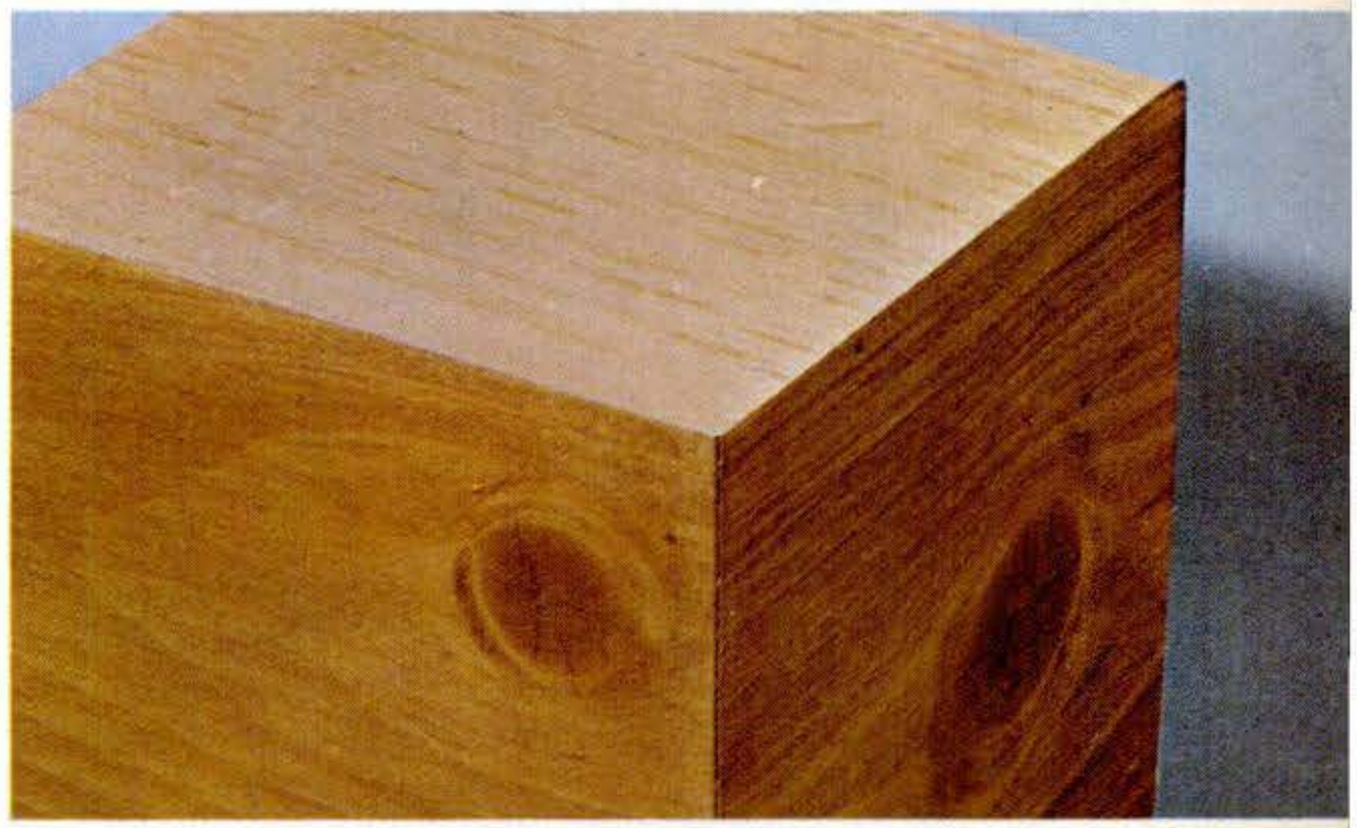
For a traditional color, these pieces of walnut (left) and mahogany (right) were treated with standard water stains in a fairly weak dilution, since woods that are naturally dark need little stain.





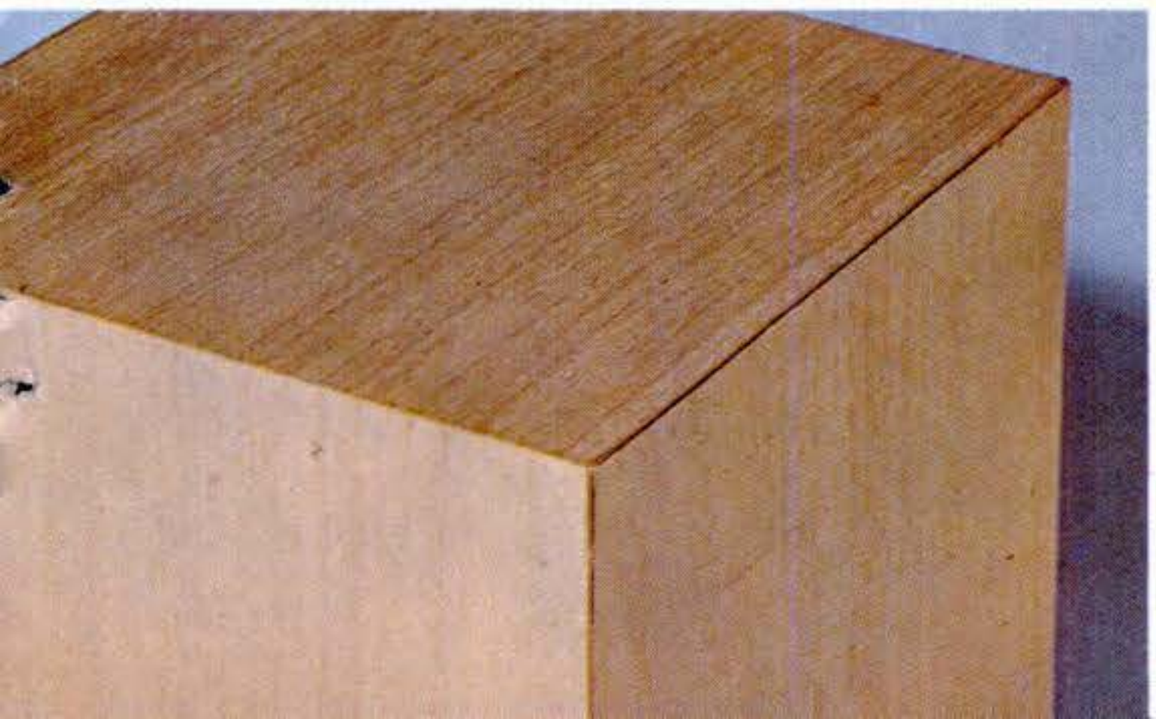
For an entirely different color, these samples of white gum and lauan were stained with a dark mahogany non-grain-raising stain. The woods now have a mahogany color, although the grain is not mahogany.

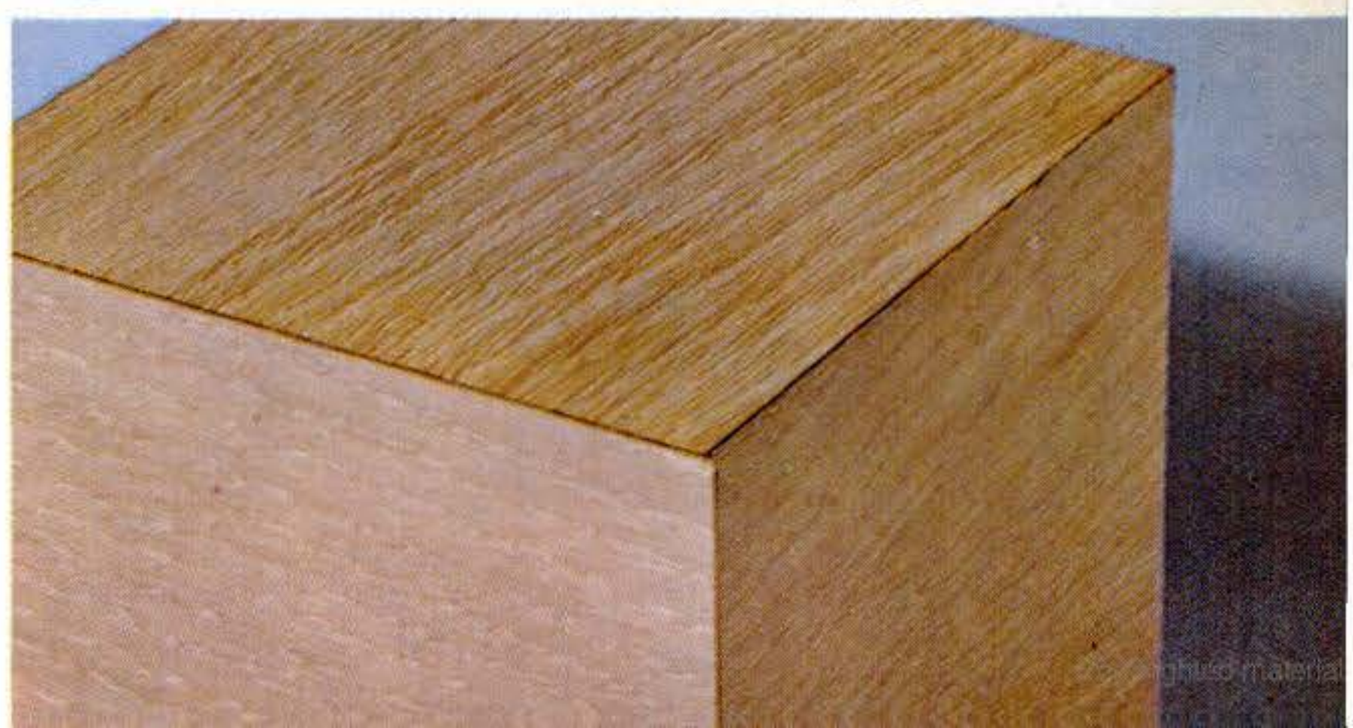




The character of wood can be changed. Above, lauan was stained with fruitwood, and pine (right) with Early American Minwax. Accenting the grain as well as the color gives the wood a distinctive appearance.

Lightening the color of wood—reverse of staining—can be done with bleach. Pale sample is walnut, treated with two-part (Albino) chemical bleach. Oak is lightened with white Firzite used as a wiping stain.





colors that please you. Constantine's stains are very close to the popular conception of what wood colors should be.

Stock solutions of water stain are strong. It is normal to dilute the stock with as much as six or eight parts of water when you use dark colors on dark woods such as walnut on walnut. At stronger dilutions, the stains will give the general wood-name color to pale species such as gum or to highly absorbent species such as Philippine mahogany (lauan).

Once you have established the color or blend and have arrived at the dilution that produces the shade you want when it is dried and topcoated, application of water stains is quite foolproof. Just be sure you flood the surface. Uniformity is almost automatic as long as you flow on the solution. Wiping away the surplus after a few minutes insures that puddles won't cause overstaining.

Let water stains dry overnight—or a shorter time in good drying conditions.

On most woods, water stains will cause the grain to "raise." Whiskers will stand up, soft-grain areas may swell, previously compacted spots may return to full size, and in other ways the surface of a well-sanded wood will again become slightly rough. If you were to resand this surface after staining, you would sand away dye-stained fibers. The remedy is to grain-raise the surface with a flooding of warm water. Let it dry. Sand again and stain.

Non-grain-raising stains. Stains that do not use water—or use only a little water—do not cause the grain to raise, since the liquids they employ do not soften the fibers. NGR stains (sometimes called NFR, for "non-fiber-raising) based on chemical by-products of the petroleum industry handle about the same as water stains, but dry for topcoating in a few hours.

The NGR stains are usually considered industrial products. For that reason they are hard to buy at retail. You can order them from Constantine or from Craftsman Wood Service Co., 2727 S. Mary St., Chicago. They come in quart bottles (or bigger) and it is a good idea to order thinner, too; you'll rarely use NGR straight.

You can make your own NGR stains, using alcohol-soluble powders and wood or denatured alcohol. This stain will dry a bit faster than commercially prepared NGR, but you can slow it down by adding a small quantity of water. A little water—in the company of the other chemicals—does not raise the grain enough to become a factor in the finishing.

NGR stains are not recommended for pine, fir, spruce, and similar woods with wide variation in density between spring and summer growth, since the grain pattern may go wild. However, they are favorites on the standard cabinet woods and are widely used in furniture factories.

True oil stains—made with dyes, not with pigments—are non-grain-raising. They are easy to use, parallel in performance to pigmented wiping stains, but without obscuring pigments. These stains are not common, however. An example is McCloskey's Tungseal (dye-colored), which is about as much a penetrating-resin sealer

The only common method of controlling wood color over an existing finish is "padding"—with lacquer or shellac used to dampen a rag. Dip the rag in powdered pigment and wipe color on, as below.

New stain idea is Even-Even. This is a thick non-grain-raising stain you buy in a toothpaste-size tube along with a plastic-foam applicator. Smear-on, wipe-off makes this one of the easiest stains to apply.

Custom stains are available in Weldwood and other brands, in the form of a penetrating vehicle into which you or the dealer stir pigments. Use them like pigment wiping stains, as described in the text.

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with color as it is a stain. It is much used for floors as well as furniture.

Varnish stains. These materials are a compromise between varnish and stain with little to recommend them except as a quick colored finish for noncritical work. Varnish stains are made by dissolving dyes in varnish. There are normally no suspended pigments. Labels are usually wood names.

You brush varnish stains on as you would varnish. They coat the surface with a semi-transparent film that obscures the wood grain to a great extent. This is why the varnish stains have little use in fine wood finishing. One coat of varnish means nothing on bare wood. You need two—or three. Since that is true, why not use a pigmented wiping stain as the first application?

Some surfaces never invite a close look—such as the insides of cabinets, backs of chests, bed rails, and the like. These may not merit the bother of the same finish you'd put on conspicuous spots. A coat of matching varnish stain is a work saver.

Padding stains. Least known among home craftsmen is a type of stain that you apply with a wad of cheesecloth. These stains are never put into liquid form. You moisten the cloth with thinned shellac or a dilute lacquer known as "padding lacquer." You touch the cloth to a little colored powder and rub it over the wood to spread the color, usually in a pattern of shading somewhat like natural variations in wood tone.

Padding stains can be used over old finishes, and for that reason one of their major uses is for touch-up. Antique dealers sometimes use them with burnt umber to put down a surface layer of pseudo-antiquity that is often convincing enough to fool a fair judge of old furniture. There is no reason why the material should ever be used over bare wood unless the objective is to give an off-species of wood (a cucumber panel in a cherry chest, for instance) a color that matches the major wood.

Since the liquids used for padding are not of great durability or resistance to moisture or alcohol, they should have a topcoating of varnish or other protection.

Walnut sapwood stain. This is a specialized material used to bring whitish sapwood of walnut down to about heartwood color, after which the entire area is stained. Craftsman Wood Service sells it. Also, you can experiment a bit and formulate your own in any of the standard types of stain.

Chemical stains. Certain standard chemicals will cause a discoloration of wood, and when the color is a desirable shade, the result is good-looking and completely fadeproof. Most useful of these—and you may want to experiment with it—is potassium permanganate. Your druggist may not sell this to you since it is a poison, but you can probably buy it at a good photo shop since it is used in photography. Mix a saturated solution; then make tests with weak dilutions. The trick is to apply the permanganate in a complete flooding. Avoid trickles. Shoot for uniformity of application and of time lapse, since the material works as long as it remains on the wood—until it reaches exhaustion. The problems of uniformity eventually lead most finishers to give up chemical stains.

Bleaches. Although they are the precise opposite of stains—they remove color from wood instead of adding it—bleaches belong in any discussion of wood-color control. There are many chemicals (oxalic acid, Clorox, hydrogen peroxide, etc.) that will bleach wood. You'll get the best results from such two-solution products as Blanch-it or Albino bleach.

Two-solution bleaches are foolproof. Following instructions on the label, you apply one solution to set up the wood chemically so the second solution can take away the color. With one treatment, a dark wood becomes pale. With two, it becomes pure white. Follow with a clear lacquer, to prevent yellowing—or with Satinlac lightener, which will hold color almost 100 percent.

Steps to a good staining job. Applying stains is one of the simplest operations in the entire finishing process. The three major types—pigmented wiping, water, and non-grain-raising—require only brushing on and wiping off, with attention to evenness. The tricks that make a stain job good lie mostly in preparation.

1. Be sure the wood is smooth, or be ready to accept the consequences of roughness. Stain accentuates roughness—even the minor scratches of cross-grain sanding. There are times when you don't mind—you may even prefer—some roughness to

Continued

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be picked up by the stain. But if you don't want blemishes to show, get rid of them.

2. Be sure the wood is clean. Uniform staining is impossible on a dirty surface, since the dirt not only may show, but may retard penetration of the stain. The best way to be sure of a clean surface is to wipe it with a product such as Cleanwoode, or lacquer thinner.

3. Be uniform. Don't sand one area with 3/0 paper and another with 6/0. The relatively rougher 3/0 area may stain darker. Don't make the mistake of expecting a surface that has gone through a jointer or planer to be ready for stain. Those tools invariably burnish the wood to a degree, sealing off some of the wood's absorbency. Sand these areas.

4. Seal end grain and some wild grain, to control overstaining. On wood that shows a big difference between soft and hard grain, you may need a thin wash coat of shellac diluted about four parts of alcohol to one part of four-pound shellac. Brush this on smoothly—not slapdash. When dry, sand lightly with 6/0 paper. It will reduce the absorbency of the softer areas and the end grain, preventing them from staining too dark. End grain sanded perfectly smooth does not need to be sealed. It takes stain in about the proper degree. This is particularly true of water and NGR stains.

5. Blend in overlight areas first—not last. Often, a piece of wood will stain lighter in one place than in another. To compensate for this, treat the light areas with diluted stain, blending them into darker surrounding wood. When this stain has dried, stain the entire surface. You'll find this easiest with water stain, most difficult with pigmented wiping stains, since they tend to seal and prevent the overall staining from penetrating.

If you're in doubt, on critical work, use a water stain or NGR, diluted to give a color quite a bit lighter than you want the final result to be. Stain overall with this. Note the areas that don't darken properly, and spot-stain them before you take the entire project down to the desired color.

6. Take time to experiment. Remember, final color is the result of stain *plus* topcoat. Keep scraps of typical woods you use on hand so that you can test stains on them before you ruin a whole project with a color you don't like. PS

Amazing Hovercraft Goes to Work

[*Continued from page 97*]

gas turbine's innards fast. The easy solution for commercial service is light concrete or asphalt aprons for overland hovering, with suitable intake filters.

Sea spray and salt-laden air—caking up and corroding the blades—are natural hazards for marine jets. Specially designed filters are licking this one.

Skirt wear is another difficulty, but more for military and cross-country ACVs than for passenger craft. This is being tackled by improved and toughened hem materials, segmented skirts for easy replacement of worn sections, and smooth bituminous treatment of abrasive hover-pads.

Tomorrow's hovercraft are going to be *big*. Operating efficiency increases with size because the ground effect doubles the lift per horsepower. And really large vessels will be needed for oceangoing runs.

The British Hovercraft Corp. has projected a 4,000-ton freighter 480 feet long. Eight turboprop engines would drive water props for a speed of nearly 60 m.p.h.

A more modest project is a 40-ton, 140-passenger craft with a single propeller giving 85-m.p.h. cruising in open water. The British government has ordered two for military tests. Next would come a 280-passenger, 80-ton design, twin propellered, with bow and stern drive-on loading.

Hovertrains, too. For fast overland travel, hovertrains hold great promise. Floating on concrete tracks, they would be supported and guided by frictionless lift pads. France already has an experimental machine running at 125 m.p.h. on a 3½-mile track.

At the Browndown Hovershow, BHC exhibited a six-foot working model running on an elevated loop circuit. Its 25-m.p.h. average speed scales up to 250 m.p.h. for a full-size 150-foot car and the air-cushion principle was ideally married to a linear induction motor for propulsion. Developed by Dr. Eric Laithwaite at Manchester University [PS, Nov. '61], this form of drive doesn't rely on friction for traction, requires no contact with the track when a built-in motor-generator is used, has no moving parts, and is silent.

One major British enterprise already in sight is the sensational 160-ton SR.N4, which is to enter scheduled service across the English Channel in 1968. A monster by today's standards, this 128-by-75-foot ferry will have 250 seats and space for 32 cars. PS

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The In Crowd knows what's happening, and what's happening is Buick '67. Proof: GS-400, Buick's personal sport car. It has a 400-cu. in., 340-hp V-8, a new brake system with dual master cylinders, energy absorbing steering column, bucket seats, heavy-duty suspension and a list of standard equipment features—including all the new GM safety items—so long it takes a Buick dealer to do it justice. (He'll also tell you how four out of five new-car buyers pay Buick-sized prices to begin with.) The In Crowd's at your Quality Buick dealer's right now. How soon can you join them?

BUICK MOTOR DIVISION

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MARK OF EXCELLENCE

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A Vietnam veteran, just back from the wars and starting a new job, wins a battle on the home front when—

Gus Puts the Brakes on a Wheeler-Dealer

By MARTIN BUNN ILLUSTRATION BY RAY QUIGLEY

Clanging to the floor of the Model Garage, a hubcap rolled a foot or so before Stan could grab it.

"Third thing I've dropped today," he said. "Wonder what that means."

"Greasy fingers," said his boss, Gus Wilson.

"Threes! Got a feeling something'll happen in threes today. Bet you a buck."

"On that long shot," declared Gus, "you get odds. Your buck against a steak."

Stan grunted agreement, and whacked the hubcap on with the heel of his hand.

As he stood up, a '63 Olds, gleaming under a wax job, rolled in. It was driven by a spare, gray-haired man Stan vaguely remembered seeing around town.

"Name's Ben Starr, of Four-Star Realty," said the driver. "One of my salesmen recommended your shop when I was beefing about a squeak I have under the hood."

"When does it sound off?" asked Stan.

"Usually when I'm parking."

"I'll take a look at your power-steering pump and belt. Will you shut it off?"

Starr did so. Stan felt the tension of the thin V belt that ran over the crankshaft, water-pump, and hydraulic-pump pulleys. It was a little too tight.

"Shouldn't be the pump," said Starr. "They overhauled it a month ago. When I complained about the noise, the mechanic said the belt just hadn't worn in yet."

Stan shook his head, then crouched to sight along the belt.

"It'll wear, alright," he said, "the way they installed it. The belt is over one-eighth inch out of line on the pump pulley. When you load the hydraulic system by making a quick turn, the misaligned belt rubs on one flange and squeaks."

"That bunch of plumbers! They got the pump out of line?"

"No, the pulley. On this model it can be put on backwards. That's what they did."

As Stan got to work removing the belt, Gus greeted Starr, whom he knew slightly.

"Jeff Hornsby was saying he'd bring his car to you," said the real-estate man. "So I thought I'd let you look at mine."

"Glad if we can help," said Gus. "I read that Jeff had been wounded in Vietnam and sent home, and was back with you."

"A good man. What he needs is a better car. A salesman can't afford one that lets him down, the way his did recently."

Soon after, having reinstalled the pulley, Stan got in and cramped the wheel over several times. There was no belt squeak. Starr drove out pleased.

"Power-steering problem number one," said Stan. "Bet we'll have two more."

Returning from a road call about noon, Gus found a '57 Plymouth on the floor. A dark young man, leaning morosely against a fender, straightened and smiled at sight of Gus.

"Morning, Mr. Wilson. It's like old times to be seeing you again."

"You, too, Jeff. I'm glad to see you back home safe, and busy," said Gus.

"Yeah, I like selling," said Hornsby. "But this crate's letting me down badly. Already cost me a commission I couldn't afford to lose. Some people came back for a second look at a place I'd shown them. When I couldn't start my car, the senior salesman horned in and made the sale."

"Tough. But let's see what we can do to keep that from happening again."

"I dunno if you can. The battery doesn't

Now! PS lies flat on your bench or table . .

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Under Sharp's stare, Gus clamped a jumper to the regulator's ARM terminal and flicked the other end on the BAT terminal, making small sparks.

stand up, though it's fairly new. It's only good for cranking a few seconds—I had to get a push again this morning."

"What happened the first time?"

"Absolutely nothing. I mean nothing at all worked—no lights, no horn, and, of course, no starter. The radio hasn't worked since, but I guess that's something else."

"Maybe. Maybe not," said Gus.

He went for a meter, which he hooked up across the battery. Then he reversed the leads. Finally he started the engine and took some more readings at the regulator.

"Okay, shut it off, Jeff. Your generator polarity is reversed, charging the battery backwards. It made a complete flip through zero to reverse polarity, which is why it went stone-dead."

"That means a new generator and two or three days' lost time in the shop?" groaned Hornsby.

"For the battery, yes. I'll have to dis-

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. New "Perfect Binding" makes easy reading

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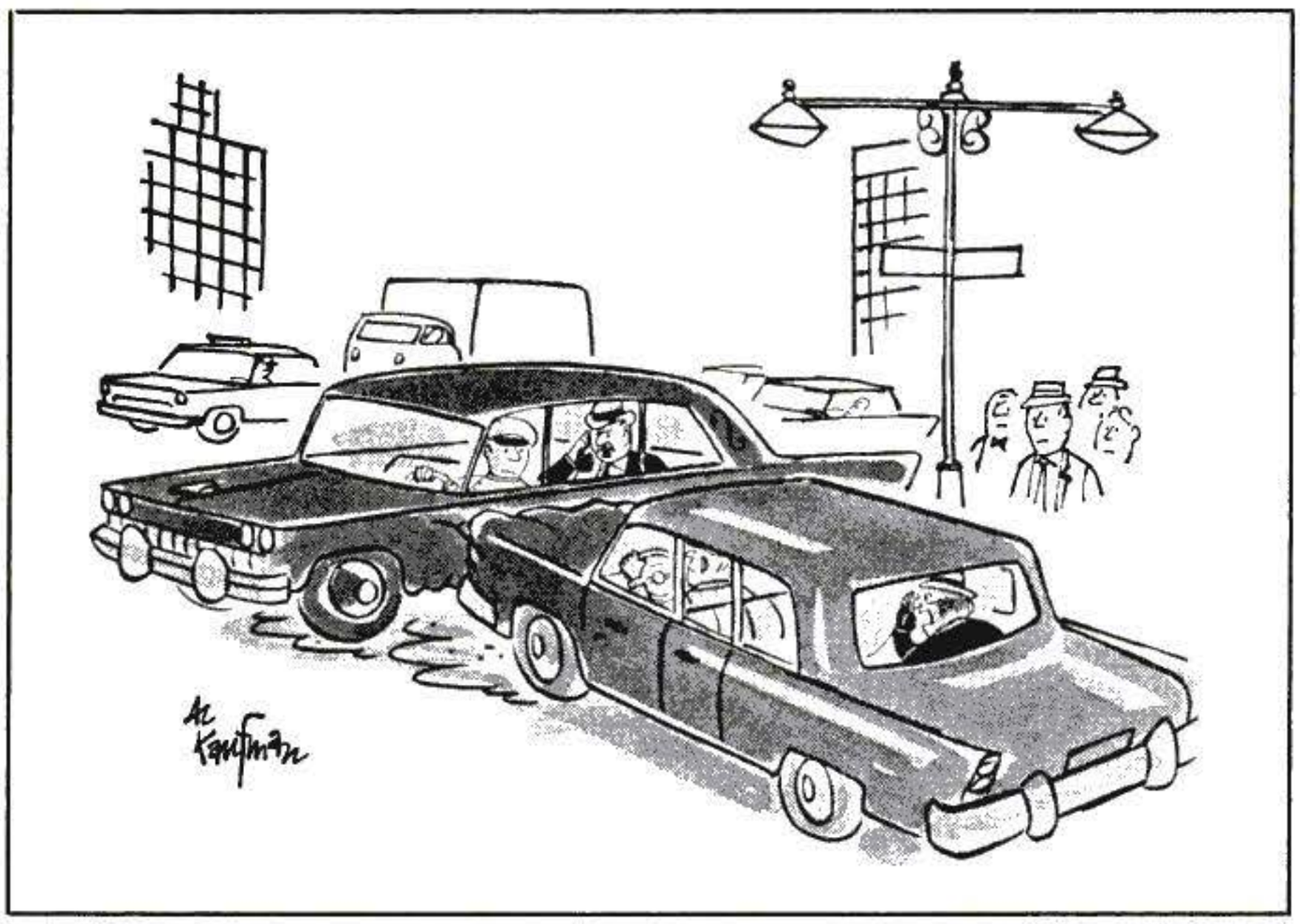
charge it and bring it up on slow charge."

"I'm sunk! You see, Mr. Wilson, that senior salesman—Tom Sharp—is well-named. There's an office record of every salesman's calls, and Sharp has a sixth sense for knowing when a deal's warming up. I have a couple keen on the big Larkin place. They promised to call me this afternoon to have another look at it. If I don't have a car to take 'em, or if it doesn't start, Sharp will take over again. I tried to rent a car, but there's a small convention in town and every rental car's out."

"Mine isn't," announced Gus. "Take my hardtop for today. By tonight your car'll be ready, with a loan battery in it."



After seeing Hornsby off in the hardtop, Gus removed the battery from the Plymouth. He connected a resistor across it, to discharge it in preparation for recharging.

Despite its misadventure, the generator showed no traces of thrown solder, high mica, or sticking brushes. Turning to the regulator, Gus found the cut-out contacts somewhat burned. He filed them carefully parallel to the armature, avoiding crosswise file marks that might cause sticking. Then he turned to the battery cables and ground connections, removing and cleaning them.

"Hey, how about some service?"

Startled, Gus looked up. A '62 Chevrolet had rolled into the shop. The man who got out sported a hairline mustache accentuating two big front teeth that gave him the look of an earnest beaver.

"Wondered if I could get a quick oil change," he said. "Got an appointment."

Seeing that Stan was finished with his brake job, Gus called him over.

"I think we can do it," Gus told the Chevy's owner. "Do you want to wait?"

"Yep. I'm Tom Sharp, of Four-Star Realty. Heard about you from young Hornsby, one of our salesmen. Doesn't this old Plymouth belong to him?"

"Uh-huh. He was in about an hour ago," said Gus as Stan put the Chevy on a lift.

"Going to have it ready soon?" asked Sharp casually.

"Tonight," said Gus. "Have to check some more and repolarize the generator."

Sharp nodded. Gus saw oil gush from the Chevy's drain. A moment later Stan approached Sharp.

"Want the filter changed, too?"

"Did that last time," answered Sharp.

Stan shrugged. "The oil's awfully dirty. Thought you might want to take a look."

Sharp did. "Okay, change the filter. But sometimes I wonder what good it does."

When he had dropped the old cartridge, Stan wondered, too. There wasn't much oil in the case, and the cartridge was, considering the state of the oil, remarkably clean. But one glance where the filter case fastened to the engine block made Stan call Sharp over again.

"You're 100-percent right. That filter did you no good at all, because no oil ever went through it. See how the gasket pinched in the groove around this plate? You have to put in a new one with each cartridge, but the old one's very tough to get out, unless you take out these two bolts and the round plate forming the inside of the groove.

"This third offside hole in the plate," Stan went on, removing the bolts, "is the oil inlet. But somebody put the plate back half a turn around, so this hole didn't register with the block inlet hole. The plate blocked it, and all the oil had to go through the bypass instead of the filter."

"Hmmf! I got nothing out of the last filter I paid for, and now I'm paying you for a new one," growled Sharp.

Continued

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some people wait for fun.
some people make it happen.

Fun knows no season. It's there for whoever is alive enough to go after it. The new way to find it in the wintertime is with an Evinrude Skeeter.

If you're a sportsman, you'll have *twice* the fun hunting and ice-fishing with your own Evinrude Skeeter. You can ride to a "stand" deep in the woods, or get way back in to remote lakes in minutes.

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For 1967, the Skeeter has been improved and modified in 55 ways. And last year's model was no slouch! Over 90% of the owners rated it *above* "satisfactory" in overall performance and operation. (You might keep that in mind if your present snowmobile proved to be a disappointment.)

Isn't it time *you* owned something that's pure fun? See your Skeeter dealer, or send the coupon for more information.

FAST FACTS: Three 1967 models, including two Wide-Track Skeeters — one with electric starting. Torque-Sensing Drive for peak performance under all conditions of load or terrain. Tough, heavy duty track with special ice cleats for extra "grab" on slick surfaces. Positive-neutral clutch control. 14 HP engine. Speeds to over 30 MPH.

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"Yes, but if I hadn't opened it, you'd still be driving with unfiltered oil."

Sharp turned away. Stan pulled out the gasket, replaced the plate properly, and installed a new gasket and cartridge.

Under Sharp's stare, Gus put a freshly charged battery into Hornsby's Plymouth. Then he clamped a jumper to the regulator's ARM terminal and flicked the other end on the BAT terminal, making small sparks. He disconnected the jumper and hooked up a meter, then checked the air gaps of the regulator contacts. When he started the engine, the meter showed the generator charging correctly.

Gus put on the regulator cover, closed the hood, and slipped an exhaust hose onto the tailpipe, letting the engine run to raise under-hood temperature and warm up the regulator before he calibrated it.

"Takes a while to repolarize a generator, huh?" asked Sharp with a rabbity grin.

"A tenth of a second. When you saw those sparks, a jolt remagnetized it."

"I thought you said Hornsby'd be without wheels until tonight?" muttered Sharp.

"Oh, no," said Gus. "He has mine."

An almost comic play of disappointment ran over Sharp's face. "Good!" he boomed heartily. "He has a big deal pending today. Wouldn't want him to muff it. He's showing the right stuff in our office."

"Why not?" asked Gus. "He did that before, the hard way—in Vietnam."

Driving Gus's car in much later, Hornsby blew a triumphant triple toot on the horn.

"I did it, Mr. Wilson! Took that couple out in your car and sold them the place for a big commission. Starr's happy. Even Sharp managed a kind word."

"Fine, Jeff," said Gus. "And your car's ready. In a day or so we'll see how your battery comes along."

"Then you found out what made my generator reverse its polarity like that?"

"Well, it can happen from hooking up a booster battery backwards, but only if the regulator contacts stick. In your case I'd say it was excessive resistance between the headlamp, or car-body, ground and the battery ground. It sometimes develops on an older car. If it does, the headlamp current may find it easier to go to the regulator ground, through the regulator contacts, to the normally negative side of the field winding, out the other side to the armature, and through its windings to ground.

"The trouble is," explained Gus, "that this current is going *backwards* through the field windings, so it magnetizes the field backwards and the output polarity reverses. But that's taken care of."

Reaching into the car, Gus flipped on a switch. Music welled up.

"I don't fix radios," said Gus with a grin. "But yours is the kind that won't work unless the car has a negative ground. For a while, it was positive and the radio simply quit. Gave me a clue, in fact. Stick around —we'll celebrate your sale."

"Where do you want to eat that steak, Stan?" asked Gus.

Shaking his head, Stan produced a rumpled bill. "Here's your buck, Gus. We did have three customers from one place, but all their jobs were different. I was betting there'd be three alike."

"Uh-uh. We had a reversed pulley, a backward-to filter plate, and a flipped generator and battery. That's three reverses in a row. The steak's on me—for three." PS

Quick aid for stranded motorists

An experimental Driver Aid, Information, and Routing system, called DAIR by GM, has been developed for calling a service station automatically when in need of help. The box at the driver's right sends a coded emergency message to the station and connects driver and station by voice radio. The system includes a visual sign minder, triggered by signals from magnets in the roadway, that lights up a panel inside the car, duplicating traffic signs and speed limits; and also a roadside-to-car communication system that transmits audio signals and can include information on traffic conditions, route accommodations, and service facilities.

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You don't stay No. 1 by standing still.

Our running improvements keep us out front.

Improvements like what? Like designing a SuperVan with a whopping 38 extra cubic feet of cargo space—while keeping the same tight 37′ turning circle as our regular Van.

But that's only the beginning. You benefit from six years of product improvements. More powerful engines, up to 240 cu. in., heavy-duty clutches, stronger bumpers. They cover everything from stronger floor to reinforced roof. A new Select-Shift Cruise-O-Matic transmission is available for manual or automatic shifting, dual hydraulic braking is standard.

These are only a few of over 50 running improvements in our new Econolines. See your Ford dealer for America's most popular Vans.

Ford

FORD ECONOLINE

VAN AND SUPERVAN

BOTH TURN IN THE SAME 37′ CIRCLE

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SS 427
For the man who'd buy a sports car if it had the room

You want a sporting kind of engine. In this case, it's a 385-horsepower 427-cubic-inch Turbo-Jet V8. Sometimes, when you're not busy, you just like to sit there and listen to it idle.

You like a hood that bulges. After all, you've got quite an engine under there. In fact, you like things distinctive and by its very markings, SS 427 stands apart from ordinary cars.

You want your car to express you just so. And happily, there's a long list of personalized touches you can add to the SS 427 — items like a new stereo tape system, front disc brakes.

Everything new that could happen...*happened* in styling, safety, performance

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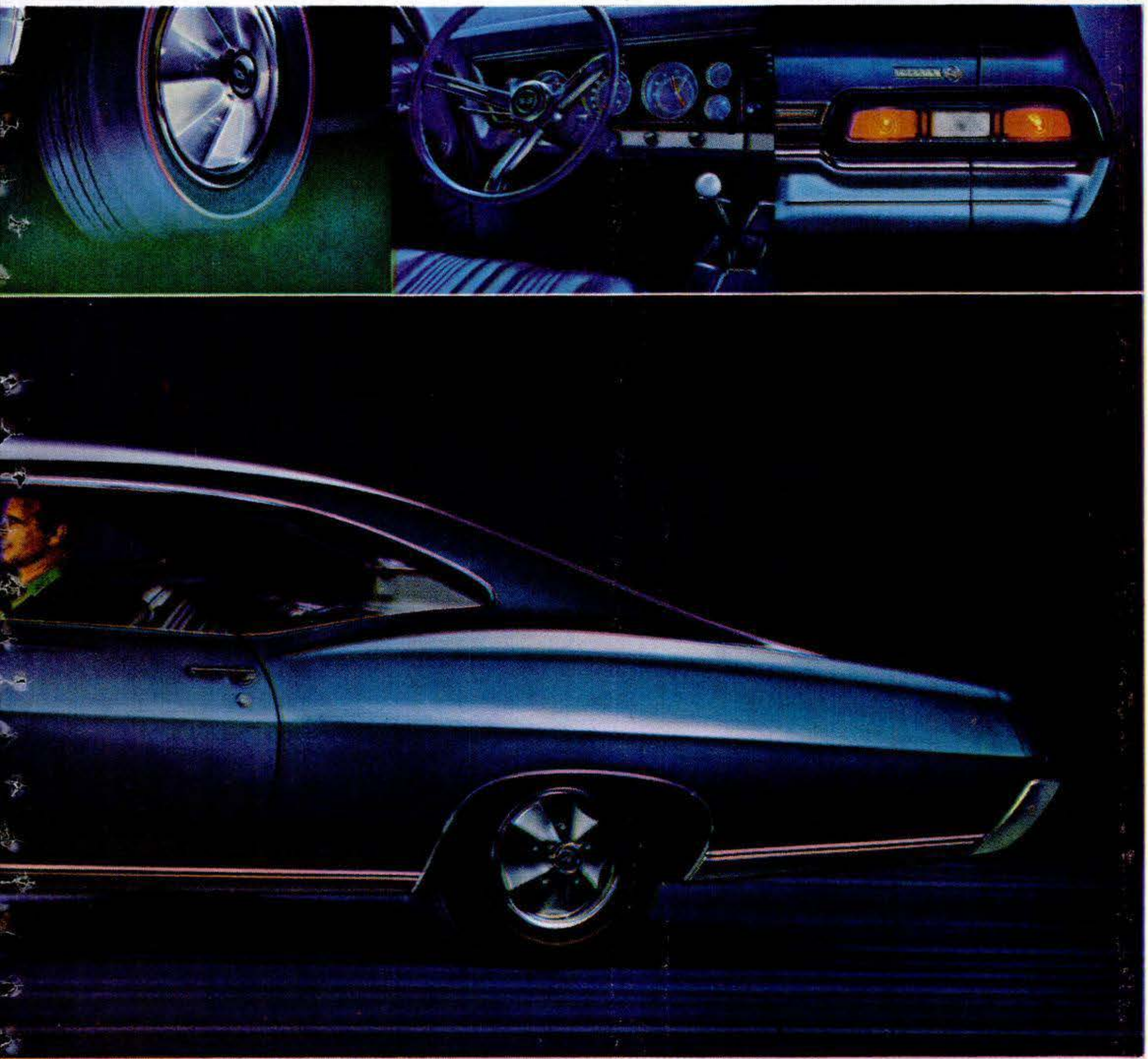
CHEVROLET

You like to unwind. So you really dig the SS 427's stiffer springs, shocks and front stabilizer bar. The red stripe tires and extra-wide rims they're mounted on help, too. All of this is standard.

You're a safety-minded individual. You like the idea of the new GM-developed energy-absorbing steering column on Chevrolets. Front seat belt retractors now standard.

You especially appreciate a dual master cylinder brake system — with a warning light to advise you of a pressure imbalance in either part of the system. Standard on all '67 Chevrolets.



New Chevrolet SS 427 Sport Coupe (Convertible, too) now performing at your Chevrolet dealer's.

'67 CHEVROLET

GM

MARK OF EXCELLENCE

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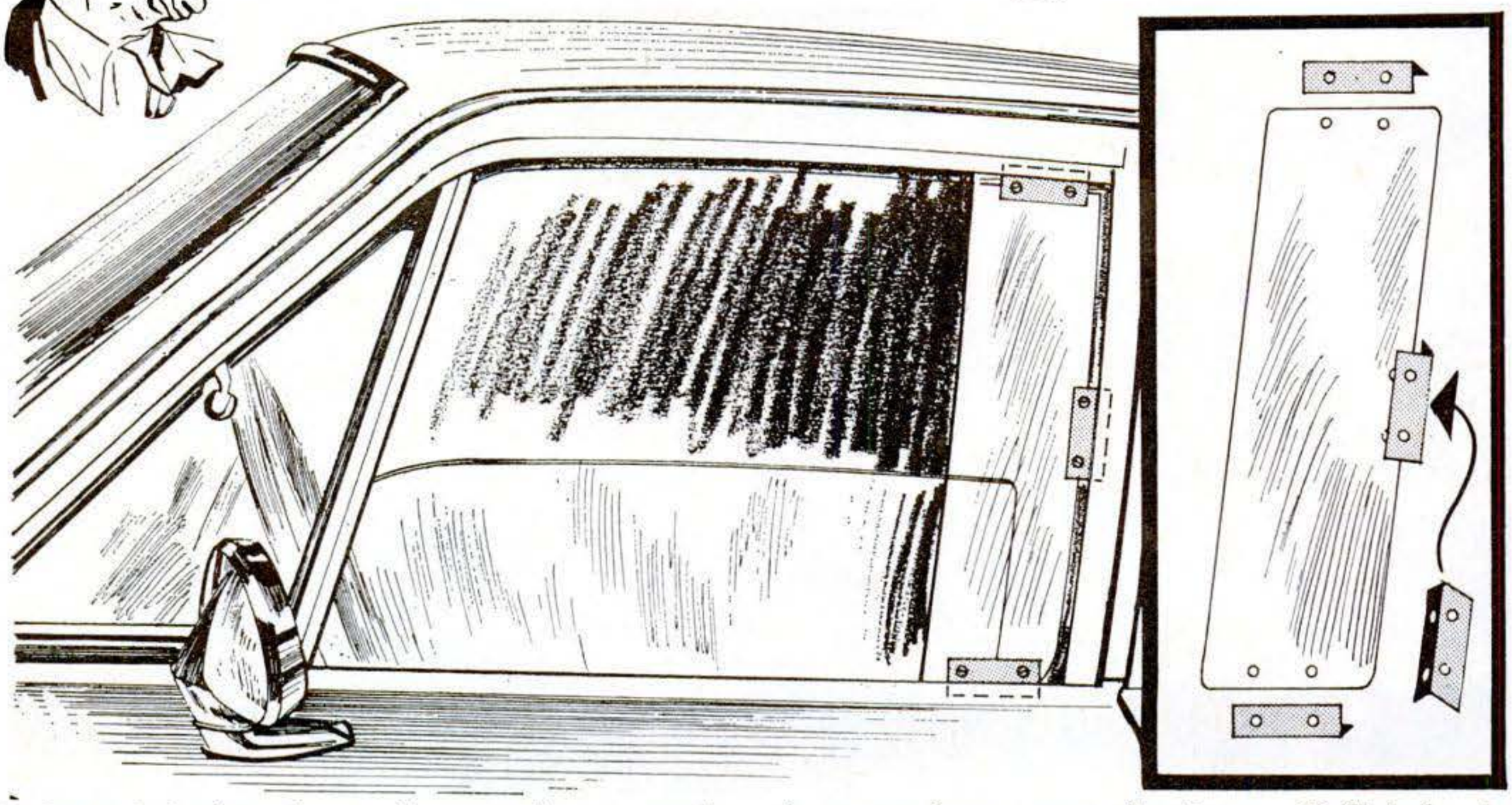
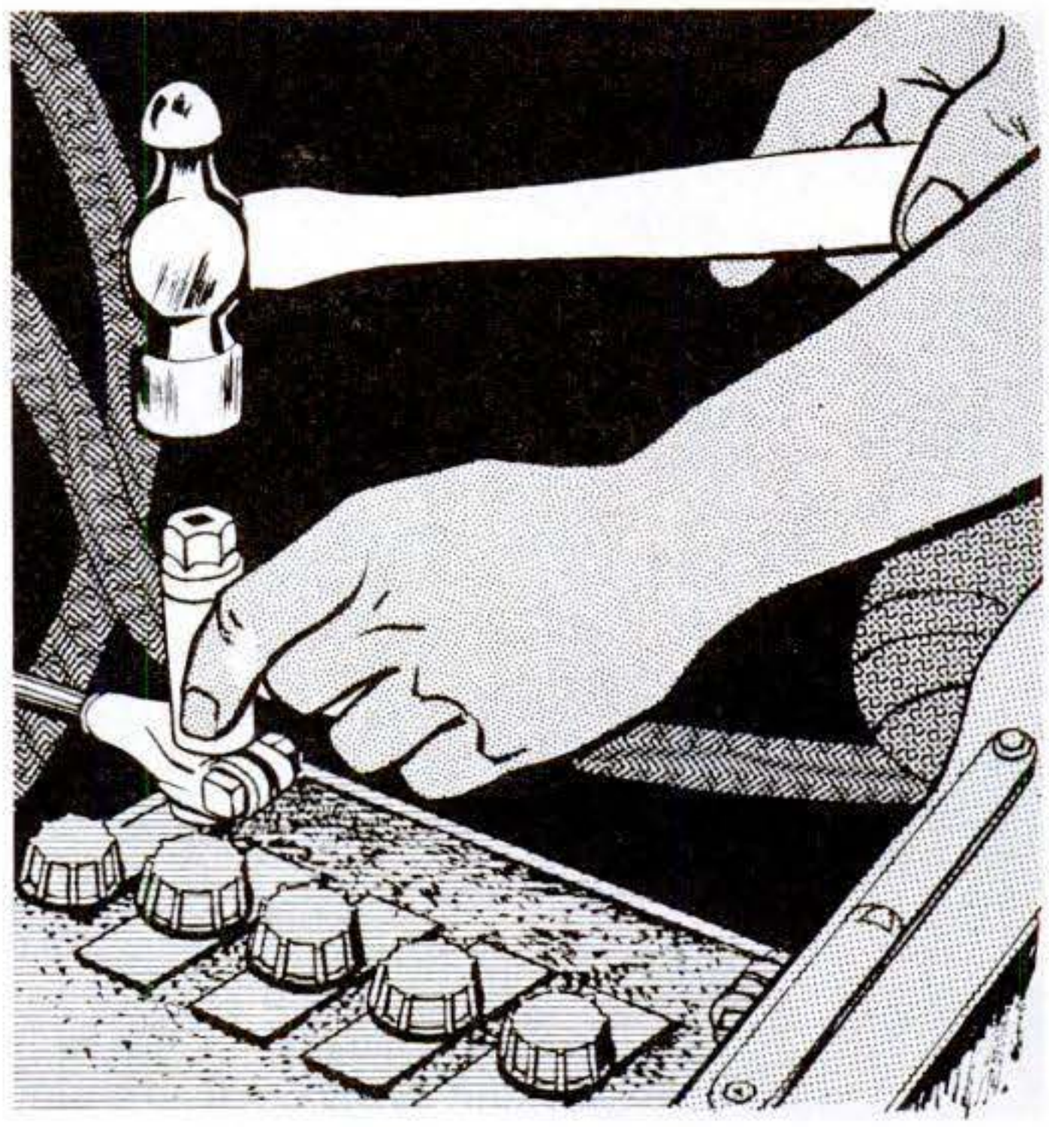
Hints from the Model Garage

DRAWINGS BY RAY QUIQLEY



Rain and drafts when a door window is partly open can give you trouble on a '65 Plymouth. This happens because of an inward slant in the glass as it is lowered or raised. To fix it, get a piece of Plexiglas and cut it, as above, following a cardboard pattern. Make four 2½"-by-¾" angle fasteners from scrap aluminum. Drill holes in fasteners and Plexiglas. Countersink the holes in the Plexiglas (on the outside). Cut eight brass stove bolts to size, drill the window frame for metal screws, and install the Plexiglas screen. You'll find your troubles are over.

When using foam rubber for trim in a car, you may have trouble finding a suitable cutting tool. Here's a handy tip: About the finest device for cutting foam rubber is a kitchen-type electric knife. It goes through foam rubber fast, leaving a clean cut without shreds.



Instead of hammering down on a battery clamp, with the risk of deforming the clamp, the battery post, or both, try this: Place a hollow spark-plug wrench on top of the clamp and tap it gently down. The hollow wrench will drive the clamp onto the post without damage.

Continued

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Superb styling has come to snowmobiles . . . Larson

You're closer to the snow for a ride that's whisper smooth and stable. That's the design engineering reason behind Larson's new longer, lower styling. The engine is up front, too, for four-way balance, easier steering, quieter running and more comfort.

Plenty smart from end to end. Plenty of storage. That's Larson . . . The snowmobile that offers superb styling with a practical purpose.

Choose the Hawk (on left) with it's use-proven 14 hp JLO engine that gives you sparkling speed and family pulling power even at high altitudes. Has molded rubber cleats with "talon traction". Yours for just $895. Or its twin brother, the Falcon—a 10 hp funster that sells for $695 (With 13 hp Daihatsu engine with electric starter—$795).

The Eagle (on right) offers all the roominess and stability a family needs. The 14 hp JLO engine drives a wider 18" track that's 50 inches long . . . only .28 psi pressure on powder snow. It's the big, handsome one . . . yours for $1045. (17 hp engine is optional).

Take a look at a Larson before you buy any brand. Compare the features and engineering. See why Larson is superior.

"Mountain proved" snowmobiles

Larson Snowmobiles

A division of Larson Industries, Inc., Little Falls, Minn. and Laconia, N.H.

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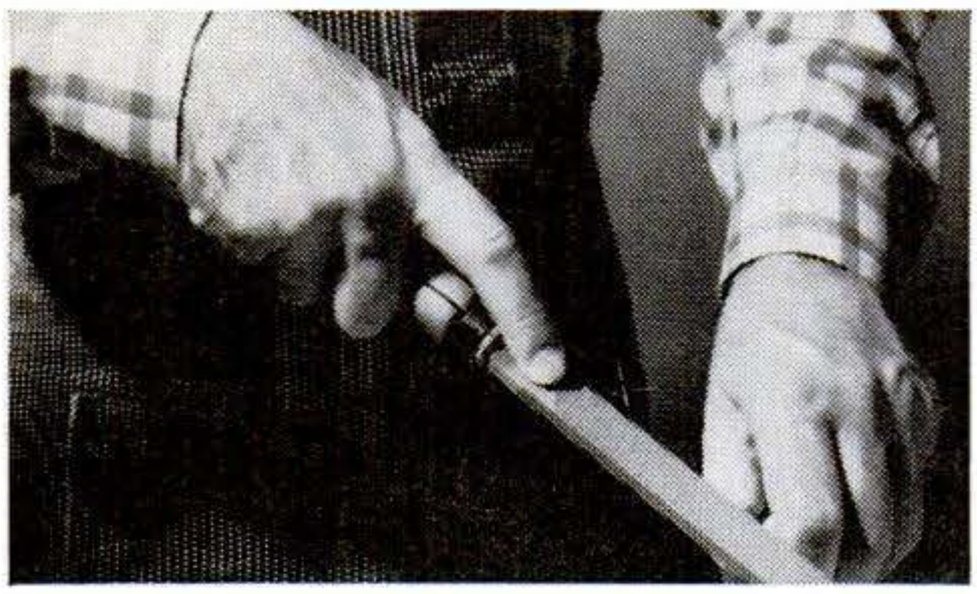
Nicholson smooths out problems



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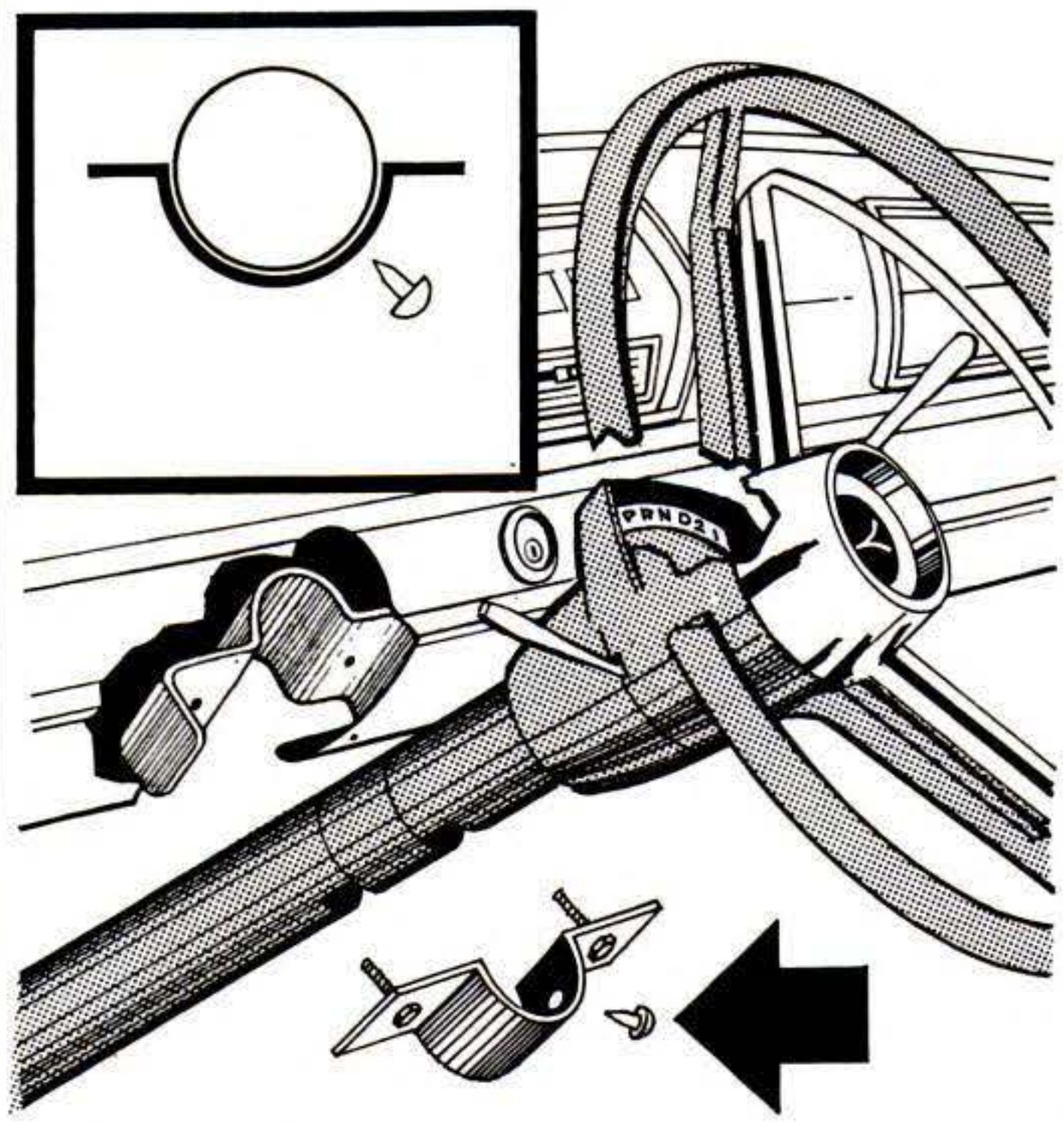
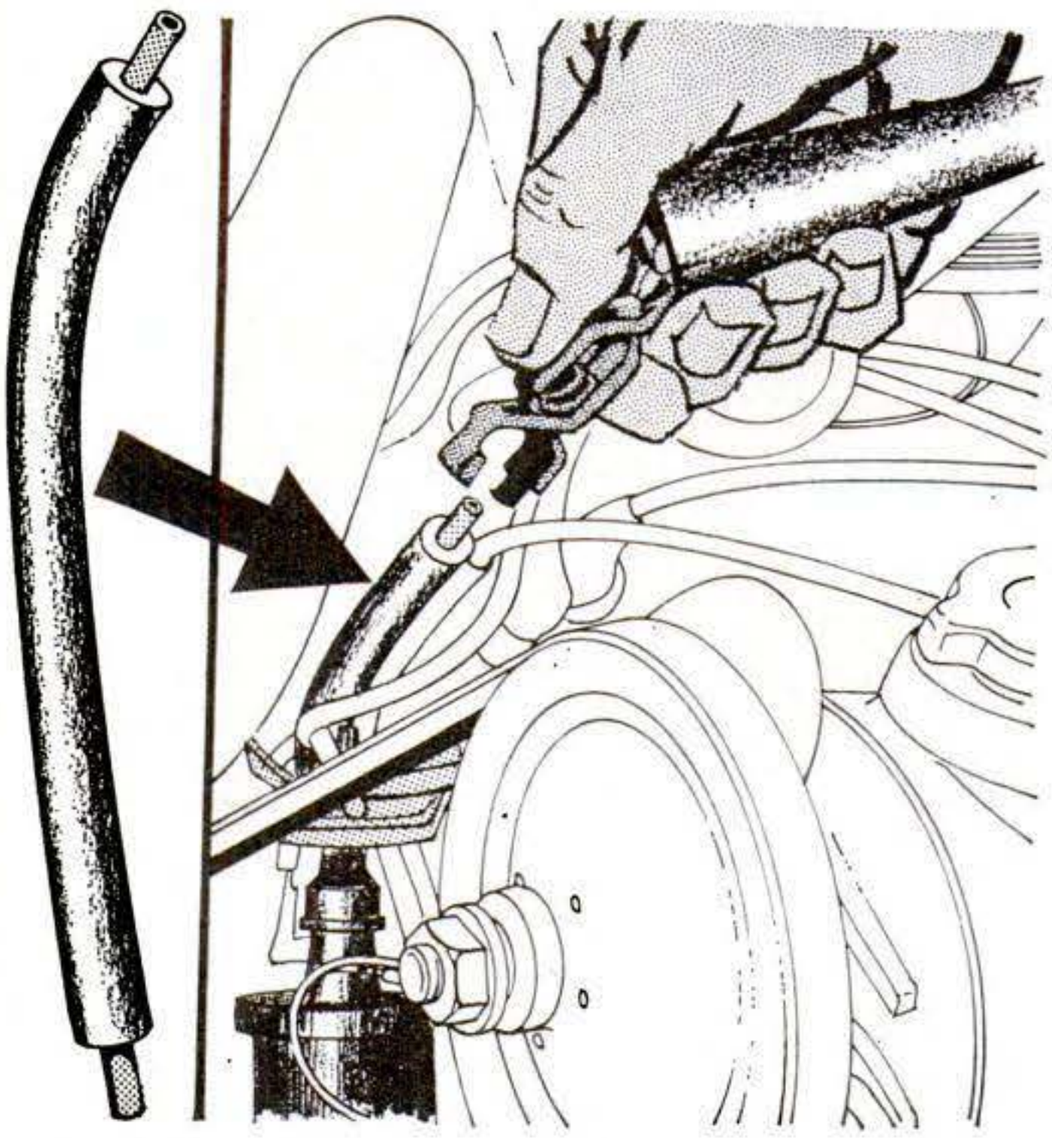
More Hints from the Model Garage



If the transmission indicator light fails on a '66 Plymouth Belvedere, the trouble may be a bad ground connection. Drill a small hole through the support bracket at four o'clock from the wheel (as shown) and insert a ground screw. Make sure the turn-signal wires are out of the way.



Hooking a dwell meter to the primary side of the coil on a late-model Buick Special is tricky. An easy way is to slide a piece of vacuum wiper hose over a length of 3/16" copper tubing, exposing 1" of tubing on either side. Hook this connector between the terminal and the meter.

Continued

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You'd never mistake Winchester's Model 190 automatic for anything but a real, honest-to-goodness rifle.

The gracefully contoured stock and forearm are of good solid wood.

The barrel is steel.

The sights are metal. And it'd take a hammer to knock them out of line.

And the receiver's made of a new rugged, rustproof metal alloy.

The point is, Winchester still believes 22's are real rifles.

The 190 is made with the same honest metal-to-wood workmanship that has always put Winchesters in a class all by themselves.

So when you take it out in the field you can be darn sure it'll work. And shoot where you point it. And keep on doing it. (The 190, by the way, can handle 21 Short, 17 Long, or 15 Long Rifle cartridges interchangeably.)

Of course, this new rifle doesn't have some of the fancy frills you get in Winchester's more expensive 22's.

Like checkering and Monte Carlo stocks, engine-turned bolts, et cetera.

But then it doesn't have the fancy price tag either.

How fast can you save up $43.95?

If you're saving up for a Winchester 22, now it won't take so long.

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you and your boy

Share a Dremel Moto-Shop. You get close to your boy when you team up with this versatile jig saw. It's ideal for hobby projects, home maintenance jobs.

But don't be deceived. Moto-Shop is not a toy. It's a dad-size tool — a craftsman's tool. Yet it's so simple to operate a small boy can master it in minutes. Completely safe, too. Moto-Shop weighs only 10 lbs. — you can store it on a closet shelf.

DREMEL MOTO-SHOP

Big capacity! 15" throat — cuts 1¾" wood, light metal, tile, plastics • Ball bearing motor • Table tilts 45° • Saws in any direction • No belts or pulleys. **Model 571** Jig Saw with disc sander (as shown), $33.95. **Model 572** Deluxe Jig Saw with disc sander, grinding wheel, wire and cloth buffing wheels. Plus 30" flexible shaft and 12 piece accessory set for grinding, drilling, routing, carving, $49.95.

Ask your power tool dealer for a demonstration or mail coupon for free literature.

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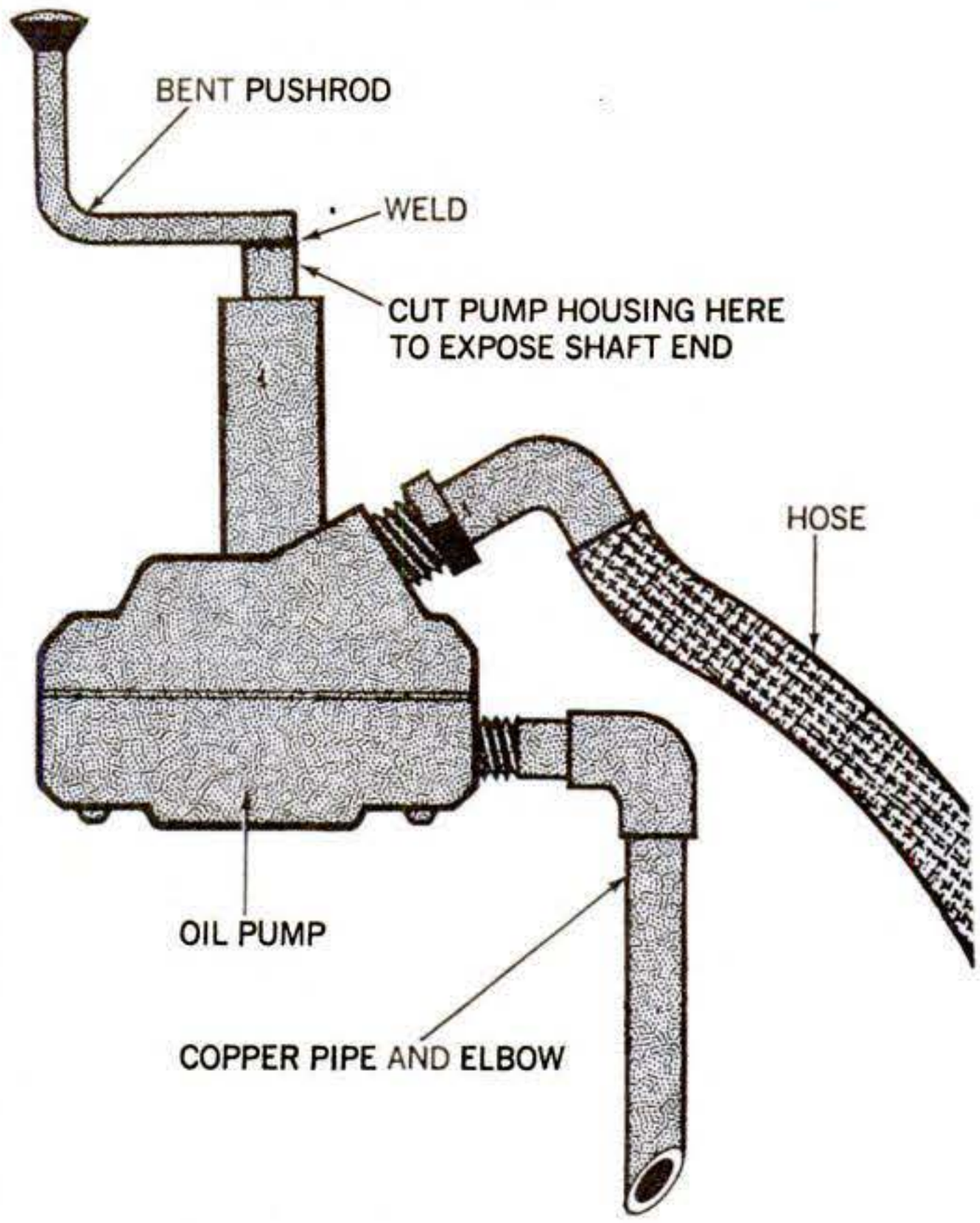
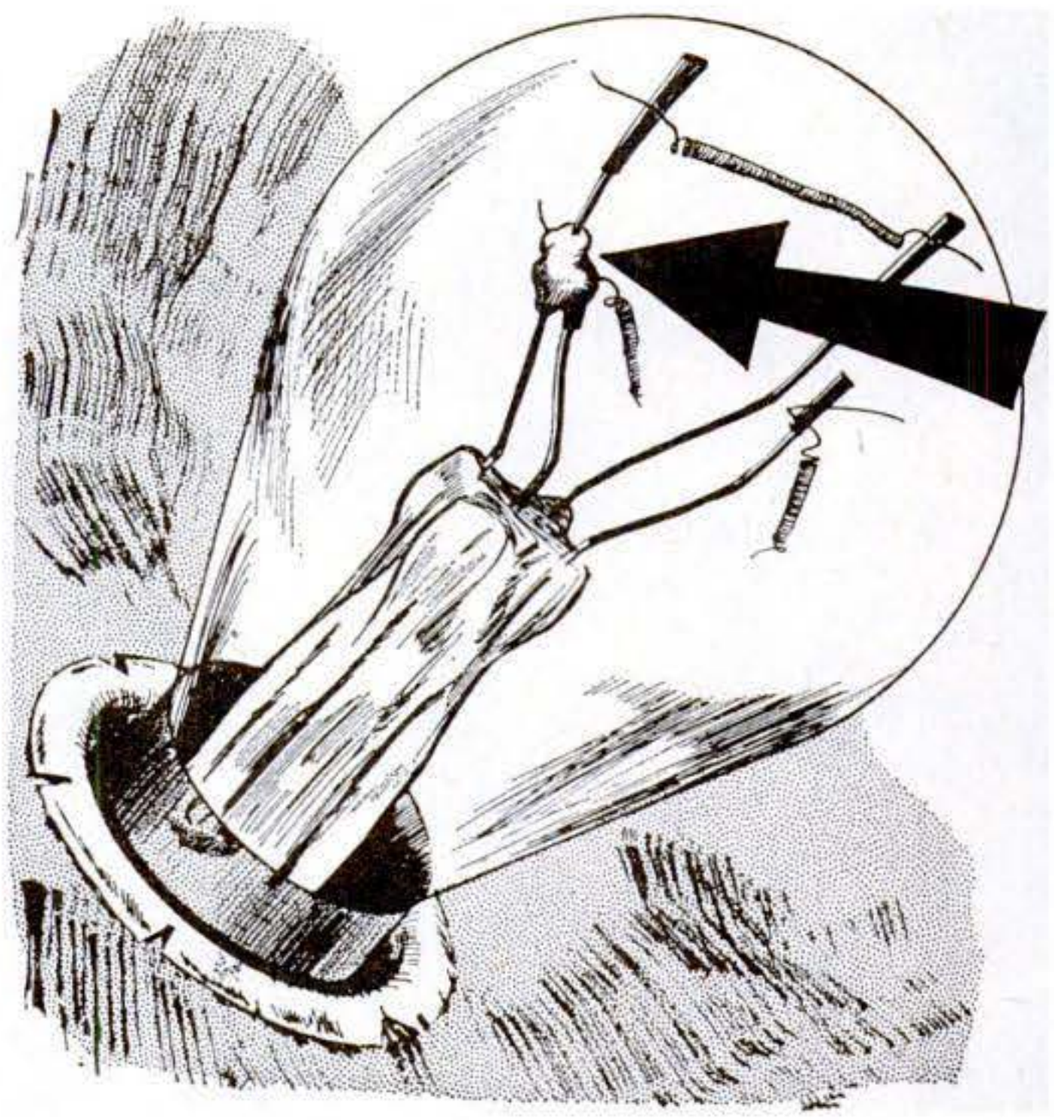
More Hints from the Model Garage



Don't throw away an old oil pump. You can make a handy little pump from it that will have a good many uses; for instance, regreasing a rear axle. The bent pushrod acts as a crank; the pipe is for suction, the hose for delivery.



When a brake light won't function and the parking lights come on instead, check the bulb. One filament in a dual-filament bulb can short it internally. A half-melted filament support may fuse to a good filament and switch the current.

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What's a nice truck like you doing in a place like this?

Here's the 1967 Chevrolet with improvements by the dozen and a sprightly new look.

The way it looks, the '67 Chevy pickup should stay out of dumps. In fact, judging by those dashing lines, this one should do only nice, polite things. But the way it *works* is something else.

Because there's never been a tougher Chevy pickup than this. It's built to last longer with new body sheet metal that fights rust and a pickup box made of double-walled steel. And it gives you more safety features and famous Chevrolet truck 6-cylinder or V8 power.

So don't let that slick appearance fool you. The '67 Chevy pickup is a roughneck underneath. . . . Chevrolet Division of General Motors, Detroit, Michigan.

CHEVROLET

A brand new breed for '67!

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The Saw That Speeds Your Plywood Projects

[Continued from page 155]

the drum in position between the rails and press the crank dowel into one end and a 3″ length of ⅝″ dowel in the other. Take care that excess glue does not squeeze out to glue the drum to the rails. When the glue sets, the crank and drum will rotate as a unit. Wrapping the drum with friction tape eliminates slip.

Mount one outboard-tiller pulley on a length of ⅜″ steel rod set in screw-eyes in the bottom edges of the rails directly beneath the drum. This pulley slides sideways to follow the rope as it moves along the drum while cranking back and forth.

Fasten two pulleys on one-by-two cross members at the rail ends. Wind stretch-free fiberglass-center clothesline five turns around the drum, run it through the pulleys, and tie it to a stiff spring at the rear edge of the carriage. Tie the other end to an S hook so that you must stretch the spring to snap the hook into a screw-eye in the front end of the carriage, putting tension on the rope so that it grips the drum tightly.

Coiled cord follows saw. Wire the saw table as shown in the blueprint, mounting an on-off switch alongside the crank. Run the supply wire to the center of the table and splice it to a 6′ coiled appliance cord connected to a single outlet on the saw carriage. The saw's line cord, rolled and bound with a heavy elastic band, is plugged into this outlet. The saw trigger is locked on, or held with a wood block. The coiled cord stretches to follow the travel of the carriage.

Crank the saw back to its starting position and fasten the ¼″ tempered hardboard table top to the rails and brackets with ⅜″ #8 flat-head wood screws, countersunk.

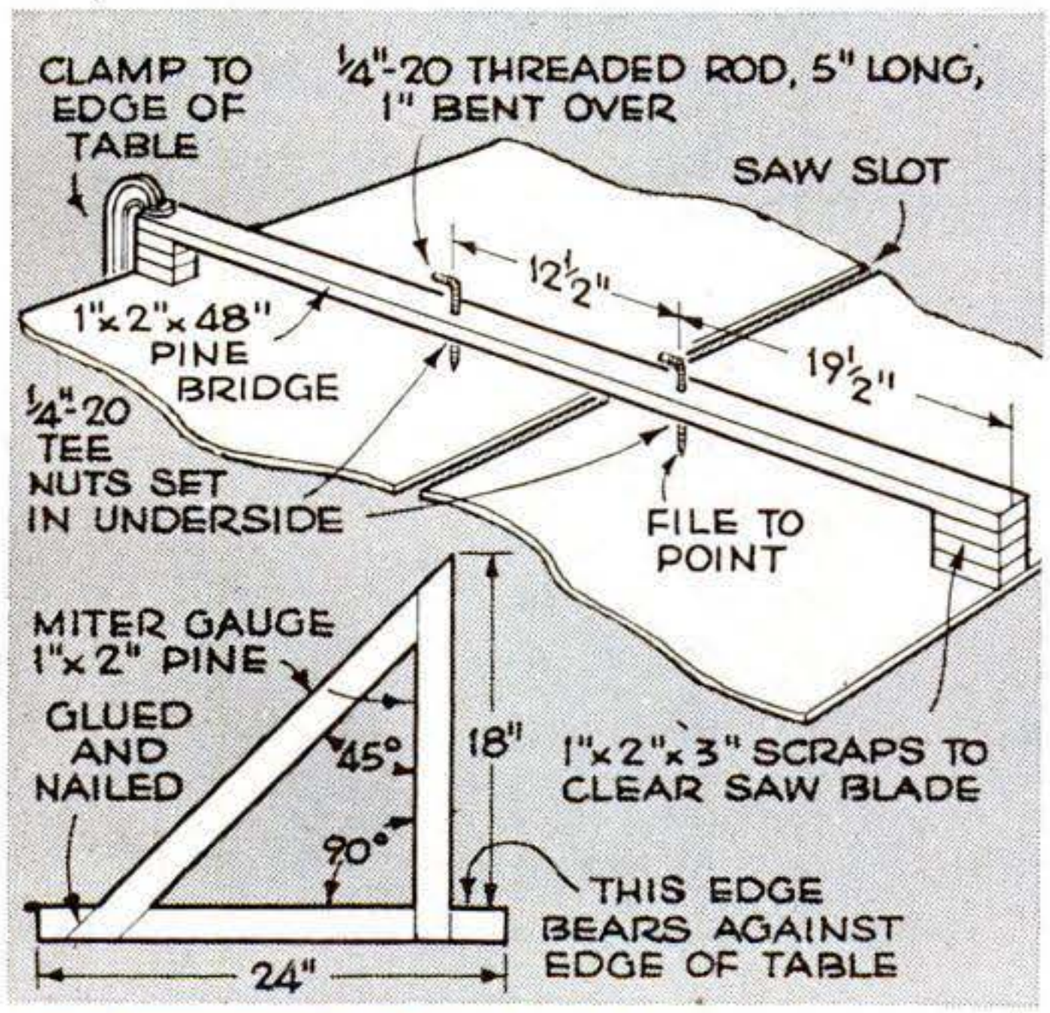
The first cut is made in the table top itself. Crank the saw slowly forward. If the blade binds, the saw is not properly aligned in the carriage. Return the saw to the starting position and adjust.

After the 90-degree cut is made, tilt the saw blade 45 degrees to make the second cut in the table top.

Make cuts by clamping the stock in place with the pencil marks lined up with the edge of the slot in the table.

Useful accessories. A simple miter head, made, as shown in a drawing, by assembling one-by-two strips into a triangular frame that bears against the edge of the table, will insure accurate 90- and 45-degree cuts.

For holding odd-shaped pieces or boards too narrow to be clamped at the edge of the table, make a pair of bridge clamps as shown in the drawing. The sharp-pointed ends of short lengths of threaded rod, turning in tee nuts set in the wood, press work of any thickness firmly against the table top for cutting. The ends of the bridges are, of course, clamped to the edges of the table top. PS



Two accessories to make your panel saw more useful—a miter head and a bridge clamp—are easily made from one-by-two stock, as in the drawing.

MATERIALS

- 1 pair folding legs
- 1 panel ¾″-x-4′-x-8′ fir plywood
- 32′ 1″-x-10″ clear pine
- 1 panel ¼″-x-4′-x-8′ tempered hardboard
- 1 gross ¾″ #8 F.H. wood screws
- 1 gross 1½″ #10 F.H. wood screws
- 2 sash locks
- 1 tension spring
- 3 outboard-tiller pulleys
- 25′ fiberglass-center clothesline
- 8′ two-by-four
- 11″ 1⅝″-dia. closet pole
- 3 screw-eyes
- 1 S hook
- 1 single electrical outlet
- 7′ electrical extension cord
- 6′ coiled appliance cord
- 1 male plug
- 1 on-off switch
- 14″ ⅜″-dia. steel rod
- 36′ one-by-two clear pine
- 4 ¼″-20 tee nuts
- 2′ ¼″-20 threaded rod
- 1 roll friction tape

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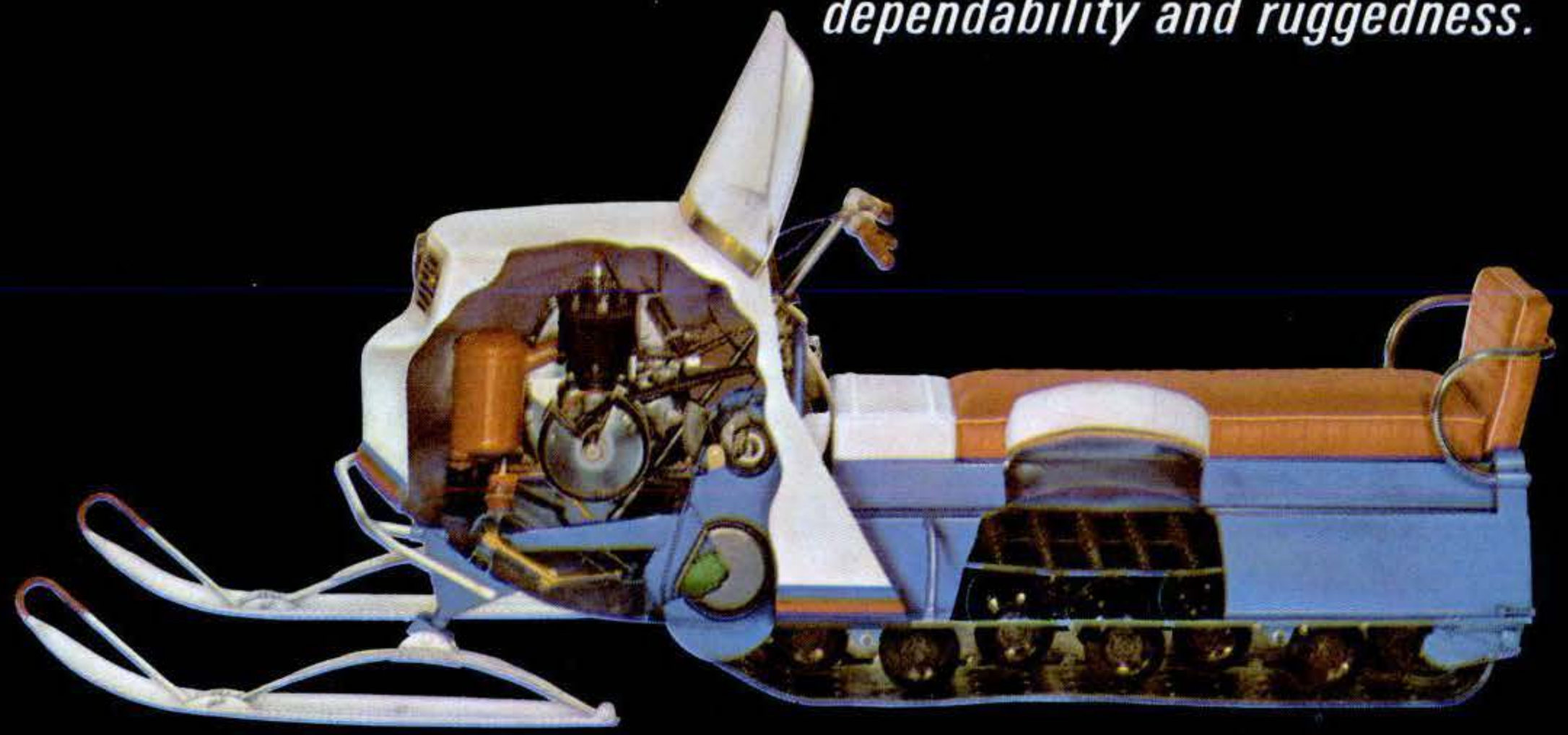
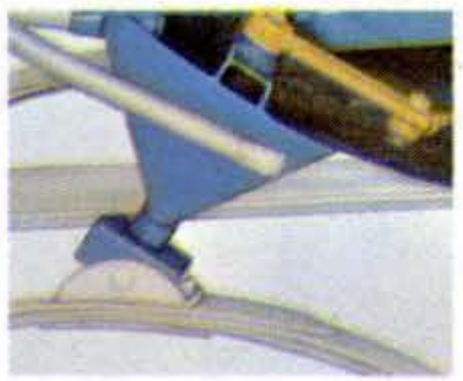
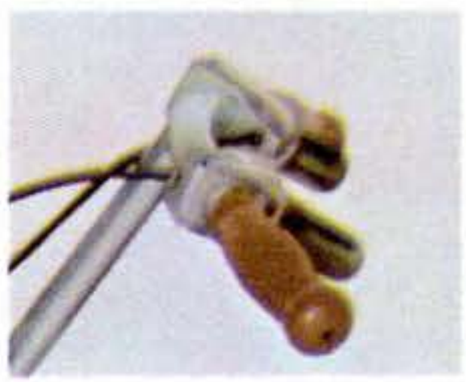
Any way you look at it... Polaris has more stability, dependability and ruggedness.



TORQUE CONVERTER AND CLUTCH. Finest torque convertor in the industry. Designed exclusively for snowmobile use by Polaris.



IMPROVED STEERING SYSTEM, triple leaf springs, splined steering spindles, ball joint tie rod ends and spring slide mounts.



THROTTLE AND BRAKE CONTROLS. The control handles are designed for optional thumb or finger control with full 360° rotation.

RAISED SEAT AND STORAGE COMPARTMENTS. Provides comfortable seating position. Storage area is large enough for rifle and other equipment. (std. w/ Mustang)

POLARIS SNOWMOBILE... built with confidence, sold with pride.

72 IMPROVEMENTS NOW CLOSER TO THE PERFECT SNOWMOBILE

72 improvements make Polaris 72 ways more dependable and stable than any snowmobile you've ever heard of.

Polaris is a rugged snowmobile that can take the punishment of grueling cross country pounding where other lighter, narrower machines fall to the side for repairs. Count on Polaris for dependability, season after season. Count on Polaris to be strong enough and tough enough to take the beating.

A wider track, wider set steering skis and a low center of gravity make Polaris an exceptionally stable machine.

This year we are offering five larger engine options, electric starting, a dash controlled muffler by-pass, snap-off hood and many other new features, plus 17 new optional accessories. Better see the rest yourself, our dealer in your area is a nice guy.

POLARIS

SNOWMOBILES

POLARIS INDUSTRIES, INC.

Dept. PS-116 Roseau, Minn.

Top U.S. Brand of Snowmobiles available everywhere

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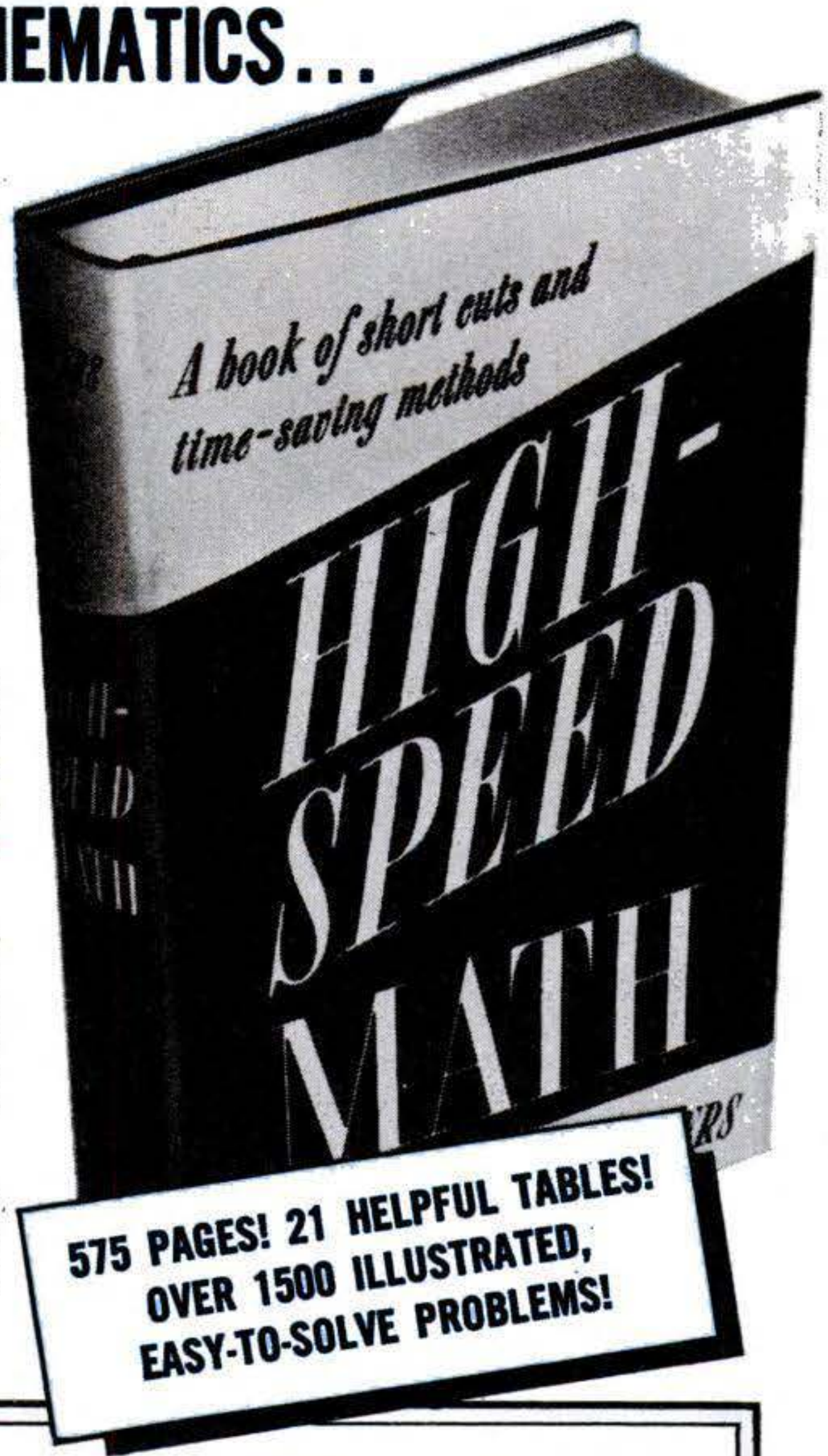

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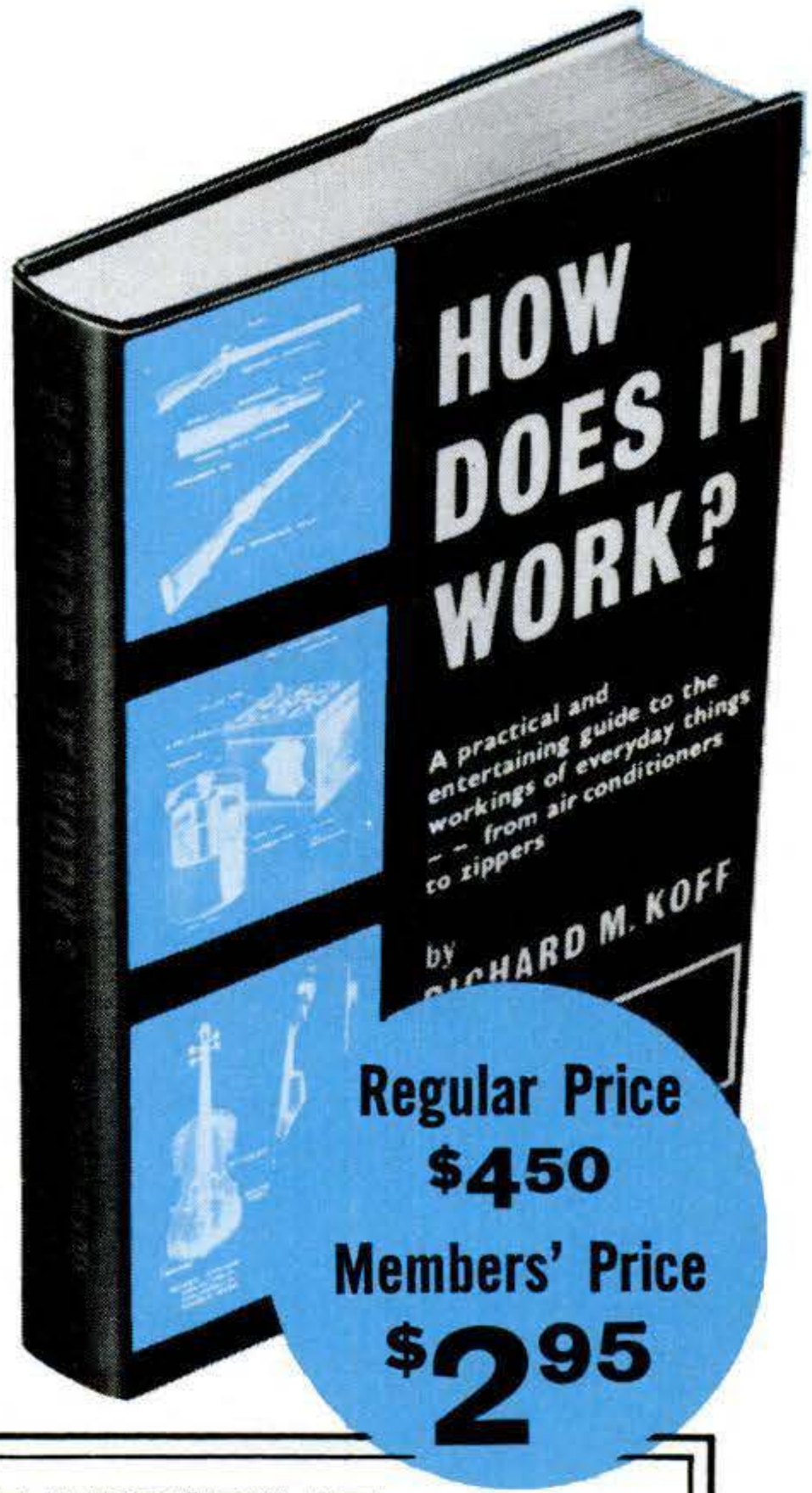
Owning this book is like adding to your household a *factory expert* for every household appliance you have, a *master mechanic* for your auto and all mechanized equipment you may own, and a *science teacher* to explain the scientific principles behind the workings of everything from rainstorms to radio tubes!

Yes, the knowledge of *all* these experts is rolled up into one big, beautifully illustrated book that will be a valuable and practical addition to anybody's library — and especially fascinating to the science-minded man. That's because HOW DOES IT WORK, besides revealing the mechanics of so many things, also goes into the scientific details behind them. You are undoubtedly familiar with the common wood screw — but did you know that it works on the fundamental principle of the wedge? (Large, close-up pictures make this principle brilliantly clear.)

No matter where you open this book, you'll find absorbing material. Did you know for example, that your TV picture is made up of a *single moving spot of light?* That in an ordinary candle it is the *wax itself* that burns, not the wick? That a common corkscrew can exert a pull of *300 pounds* — often necessary to remove a stubborn cork?

Of course, HOW DOES IT WORK deals with more complicated things too — your automobile's engine, transmission and electrical system, thermo-electricity, electroluminescence, AM and FM broadcasting, stereo hi-fi sound reproduction, ultrasonics, much more. Home appliances and household items include can openers, traverse rods, lawn mowers, blenders, mixers, toasters, irons, waffle irons, faucets and valves, sewing machines, ovens and ranges, musical instruments, much more.



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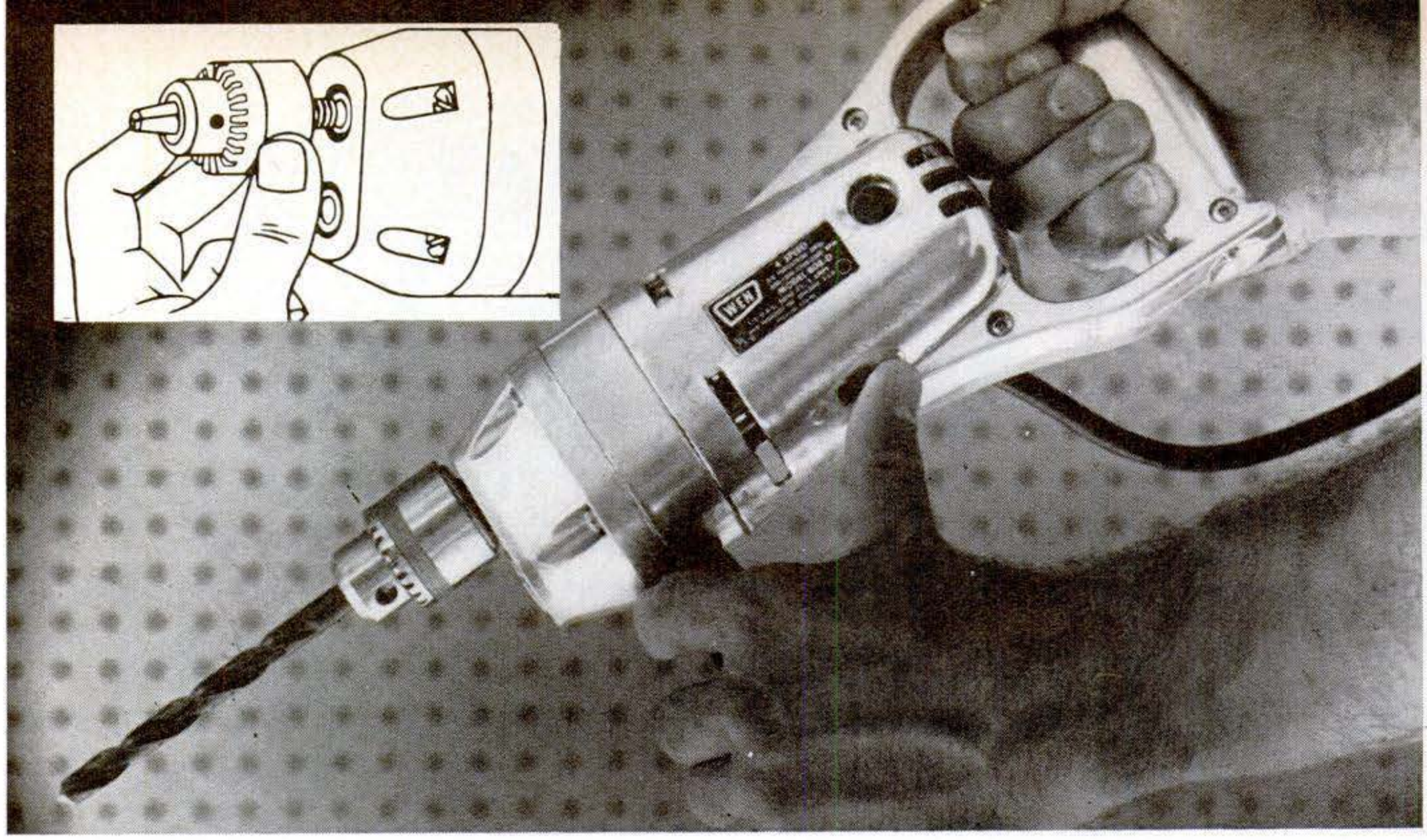

Wen's new four-speed 3/8" electric drill will give you just about any required speed in one handy tool. It was a headliner in a preview of National Hardware Show products, opened to POPULAR SCIENCE by the manufacturers. As seen in the sketch above, you shift the chuck to one of two spindles for high or low speed range. One spindle gives speeds of 1,800 or 1,300 r.p.m. To choose, you flip a selector button on the side of the housing and a solid-state motor control sets the speed. On the other spindle you have a choice of either 650 or 450 r.p.m.

A D handle plus a straight auxiliary handle provide operating ease in any position. The auxiliary screws into the housing either at top or bottom. You just squeeze to operate the on-off switch, located within your grip in the D handle. The drill has a two-amp motor, three-wire cord, weighs 4½ pounds, and is priced at $29.95.

Roundup of New Tools for the Hardware Show

A unique telescoping wrench designed to replace the entire set of basin wrenches that plumbers carry was the eye-catcher from the Ridge Tool Co., Elyria, Ohio. The Ridgid No. 1017 (below, left) telescopes from 10" to 17" and a lock holds the slide in any of four positions. Ridge also has a new 10" straight-shank basin wrench. Both wrenches are made for either pipe or hex nuts.

Two new ratchet-action tube benders from Ridge, one for ½" nominal tube, one for ¾", produce any bend from 0 to 180 degrees with plus or minus 1/32" accuracy and with less than five-percent flattening. A 13:1 mechanical ratio produces 13 pounds' bending pressure for every pound of force you exert. The tools (below, center) bend hard copper, steel, and stainless steel.

Ridge also showed three new automatic-locking steel tapes in lengths from 10' to 16' and widths from ½" to ¾'.

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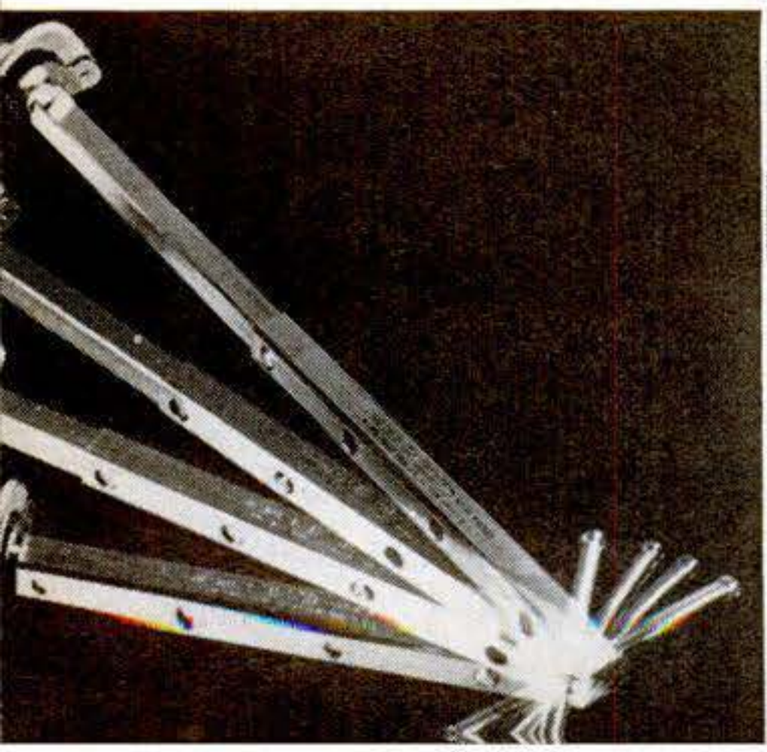

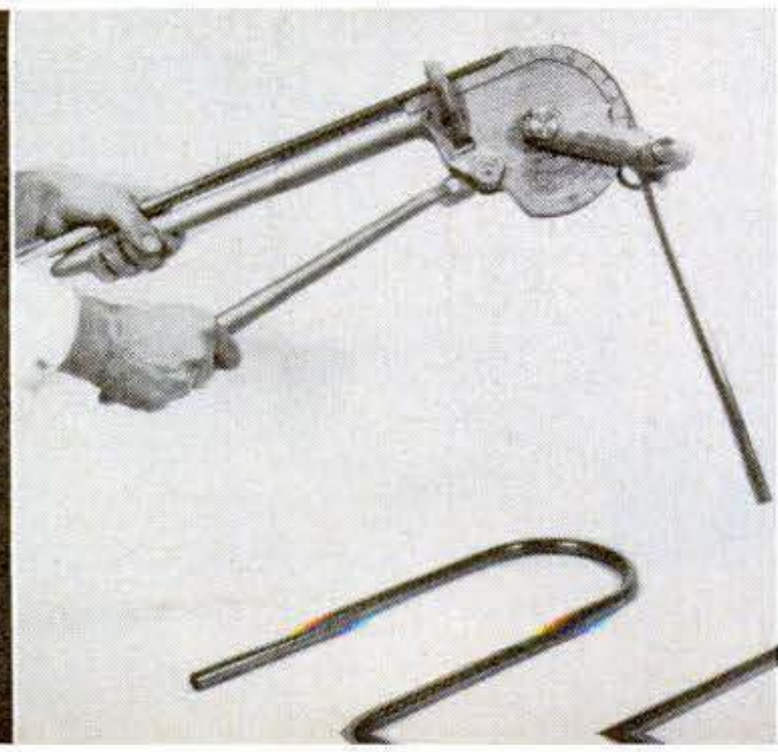

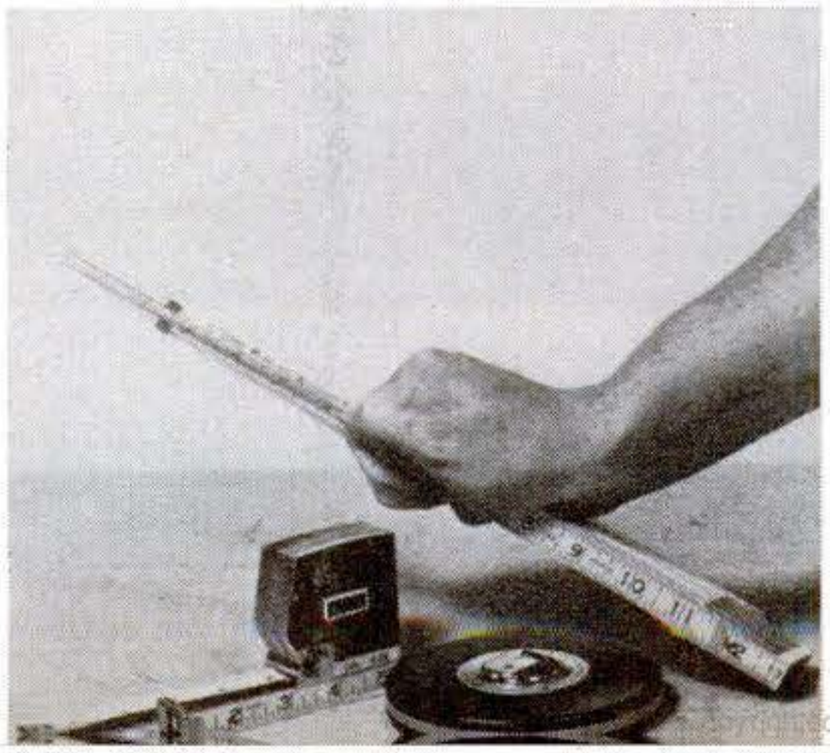

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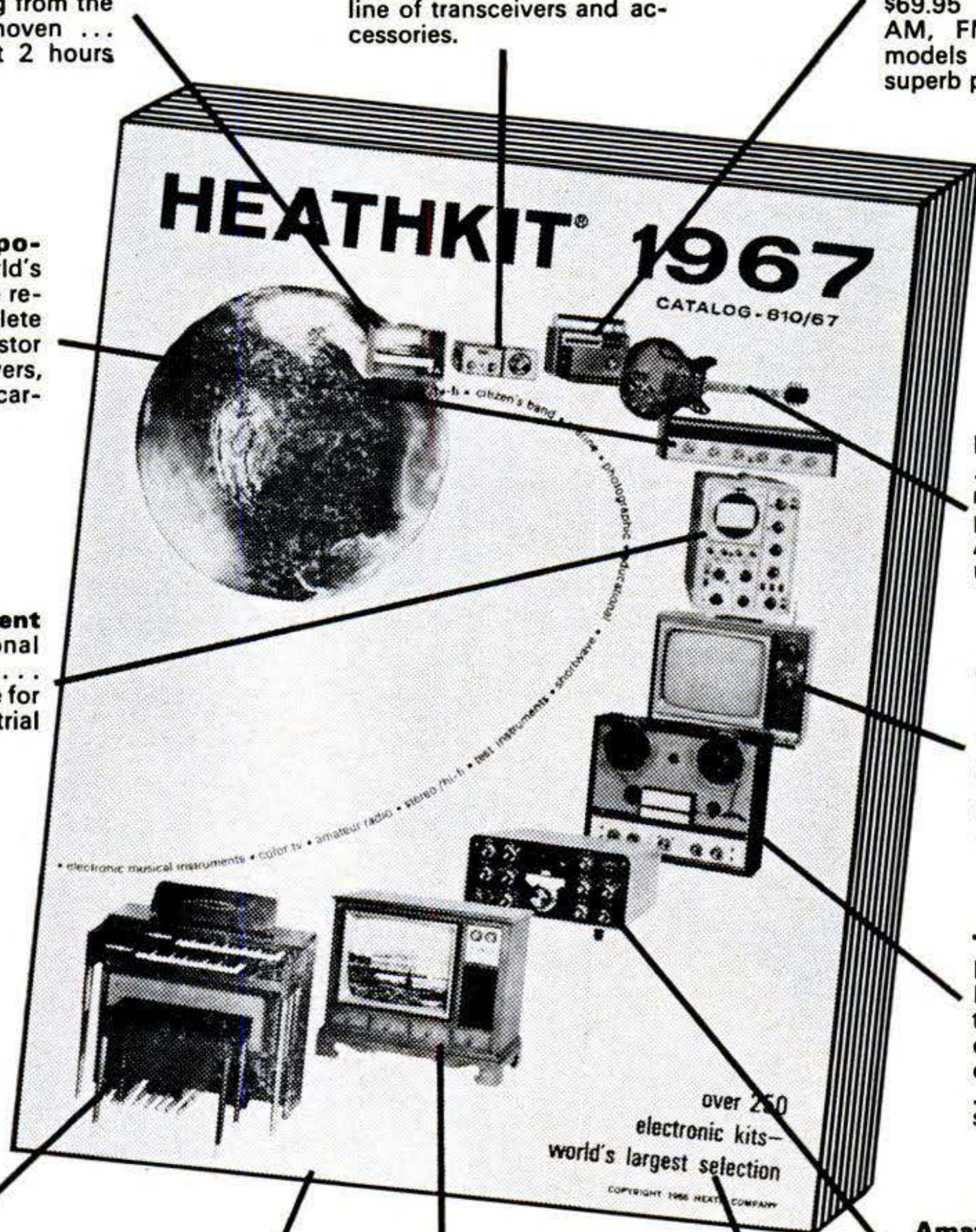

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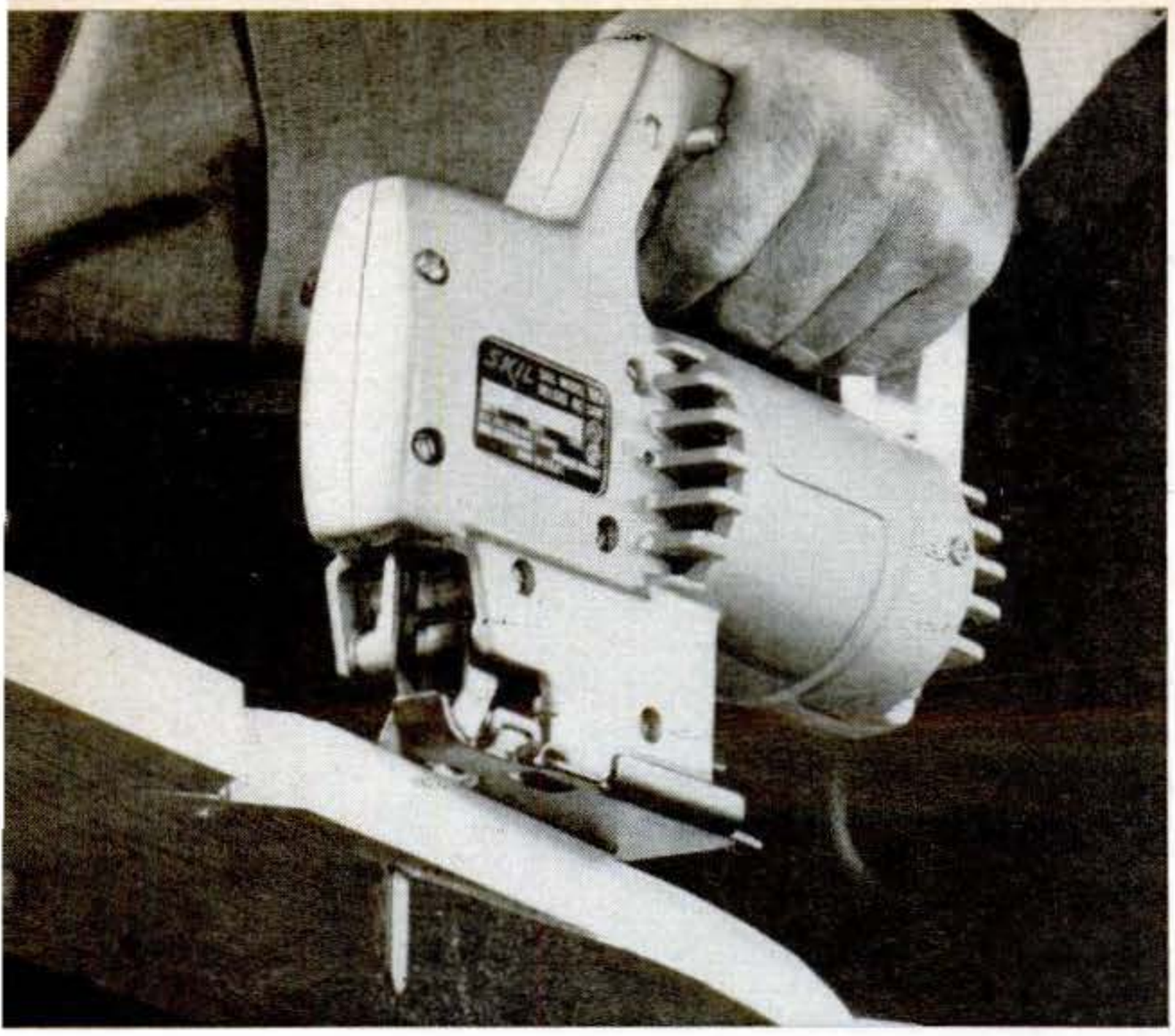
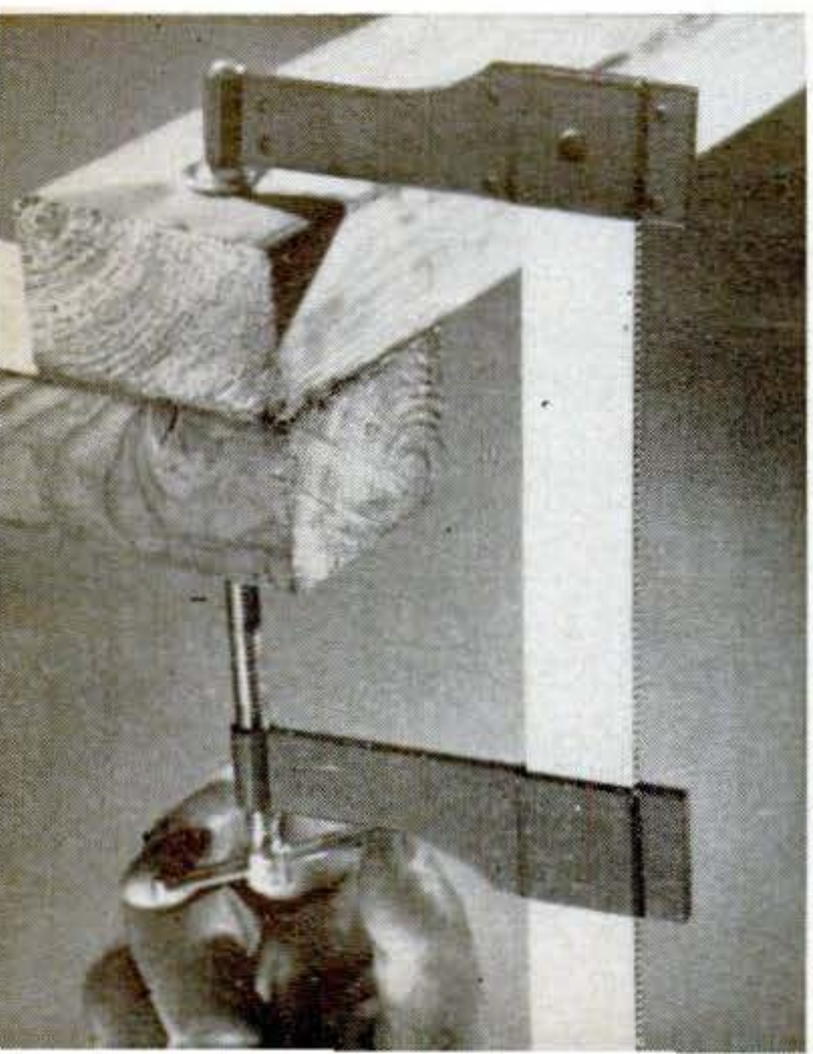
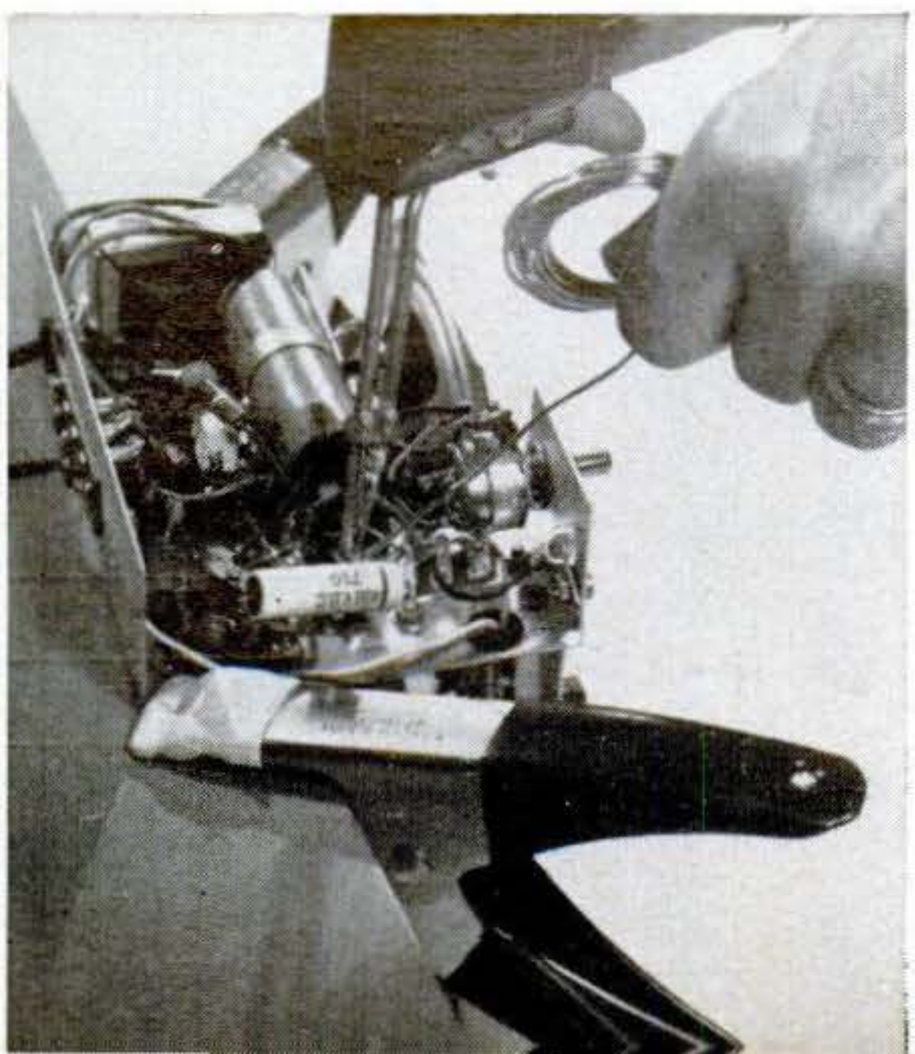


Two new Skil saws—a circular saw and a jigsaw—have professional-tool guts but a home-shop price tag—$39.95 each. Both were included in the exhibit planned by Skil Corp. for the National Hardware Show in New York City's Coliseum early in October. The 7½" Model 574 circular saw has helical gears, machined housing, safety-stop brushes, Vari-torque clutch, sawdust-ejection system, and a hard-tooth combination blade. The Model 524 2.3-amp jigsaw has orbital blade motion for fast cutting action, and comes with an attachment for splinterfree cutting. Both saws have burnout-protected motors that take the danger out of overloading.

A de-stroking port for easier starting was a feature of several chain saws presented by McCulloch Corp. at the show. McCulloch added this to several professional saws early in the year. Latest to get it is the Mac 3-10, shown at left, an 11-pound saw for home owners and other occasional users. The port is a valve located near the top of the combustion chamber. When you turn on the ignition switch, you also press a button, opening the port and releasing compression. This reduces, by up to 50 percent, the effort necessary to pull the starter rope. When the engine fires, you release the button and get full compression. In the new electric-start McCulloch saw, announced in October PS, a de-stroking port works automatically.





Handy new clamps were presented at the show by Stanley. At far left is an adjustable bar clamp with maximum opening of 6"; at near left, a new spring clamp. The latter, which comes in three sizes, has soft plastic tips to prevent marring of the work. Stanley also has new nickel-plated clamps in three sizes, and a set of nut drivers for seven sizes of hexagonal nuts and bolts.

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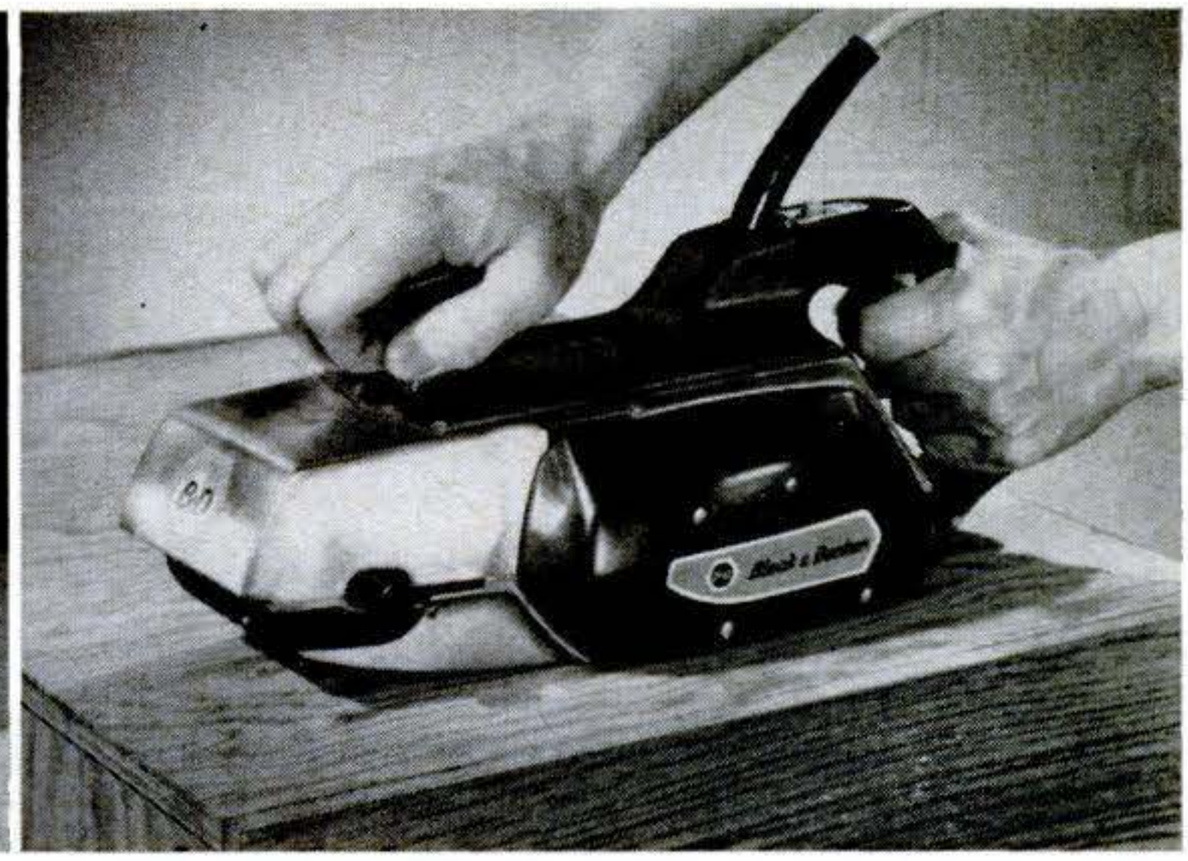
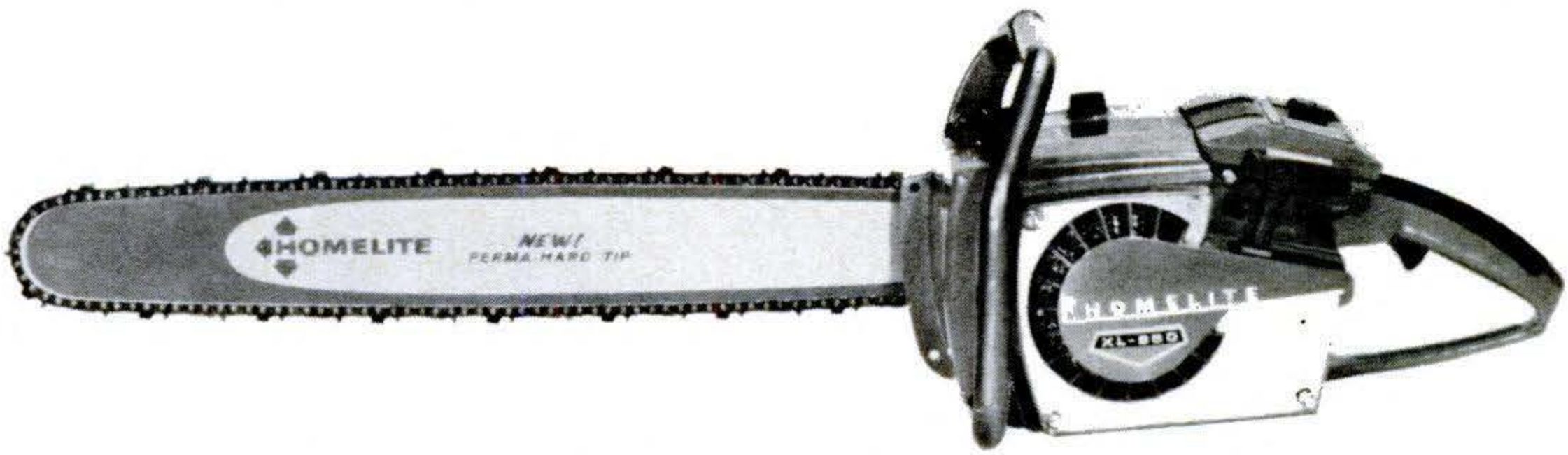
Tools for the Hardware Show



Two belt sanders of a new design have been introduced by Black & Decker for home-shop use. In each, the motor is located within the belt periphery and width. This design lowers the center of gravity and gives you better control of the tool, reducing tilting and gouging. Both sanders have a flush side for sanding near vertical surfaces. Model U-244, shown here, has two speeds—1,250 sanding feet per minute for fast wood removal, 1,050 feet per minute for finishing. It has a ¾-hp. motor, sells for $59.99. Model U-144 has a ⅝-hp. motor, sells for $49.99. Both sanders use 3"-by-24" belts and both accept B&D's $6.95 dust-collector attachment.



Solid-state ignition has now come to chain saws in Homelite's new 14½-pound XL-850. That means the system has no breaker points. The solid-state unit breaks the circuit electronically. Since there are no moving parts, ignition failures caused by wear and pitting are eliminated. The XL-850, one of 13 Homelite chain saws at the show, sells for about $280 with 16" cutter bar.

New wide-cut radial-arm saw makes 24" crosscuts and 34½" rip cuts, as on a heavy-duty industrial saw. The big difference? The Model 1000 Long Arm, by Toolkraft, Springfield, Mass., is priced for the home shop—$289. It gives you the capacity to handle those awkward cuts on four-by-eight panels. Specs: 1⅛-hp. motor, 10" blade, 24"-by-32" table, cuts 3⅝" at 90 degrees, 2" at 45.

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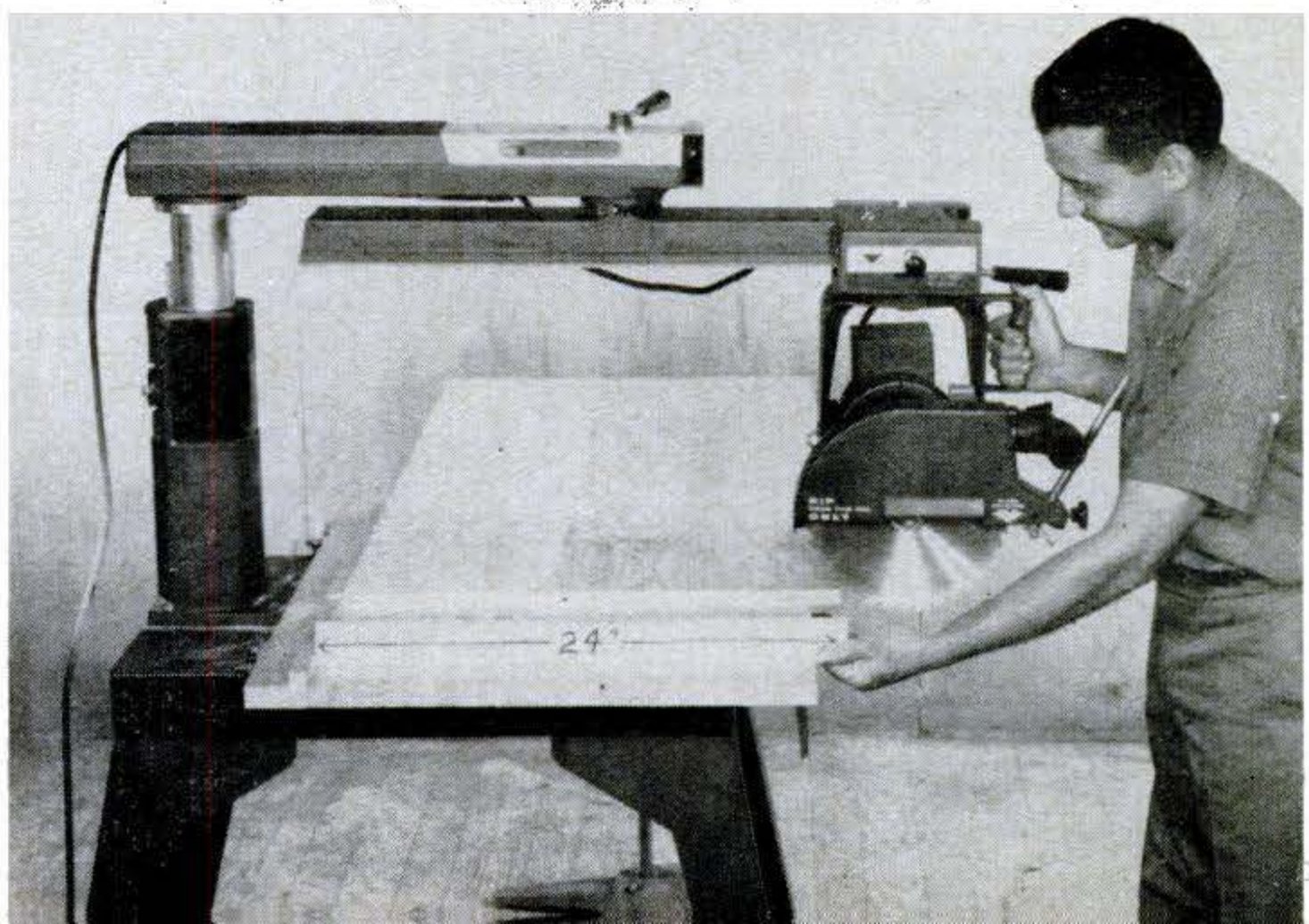

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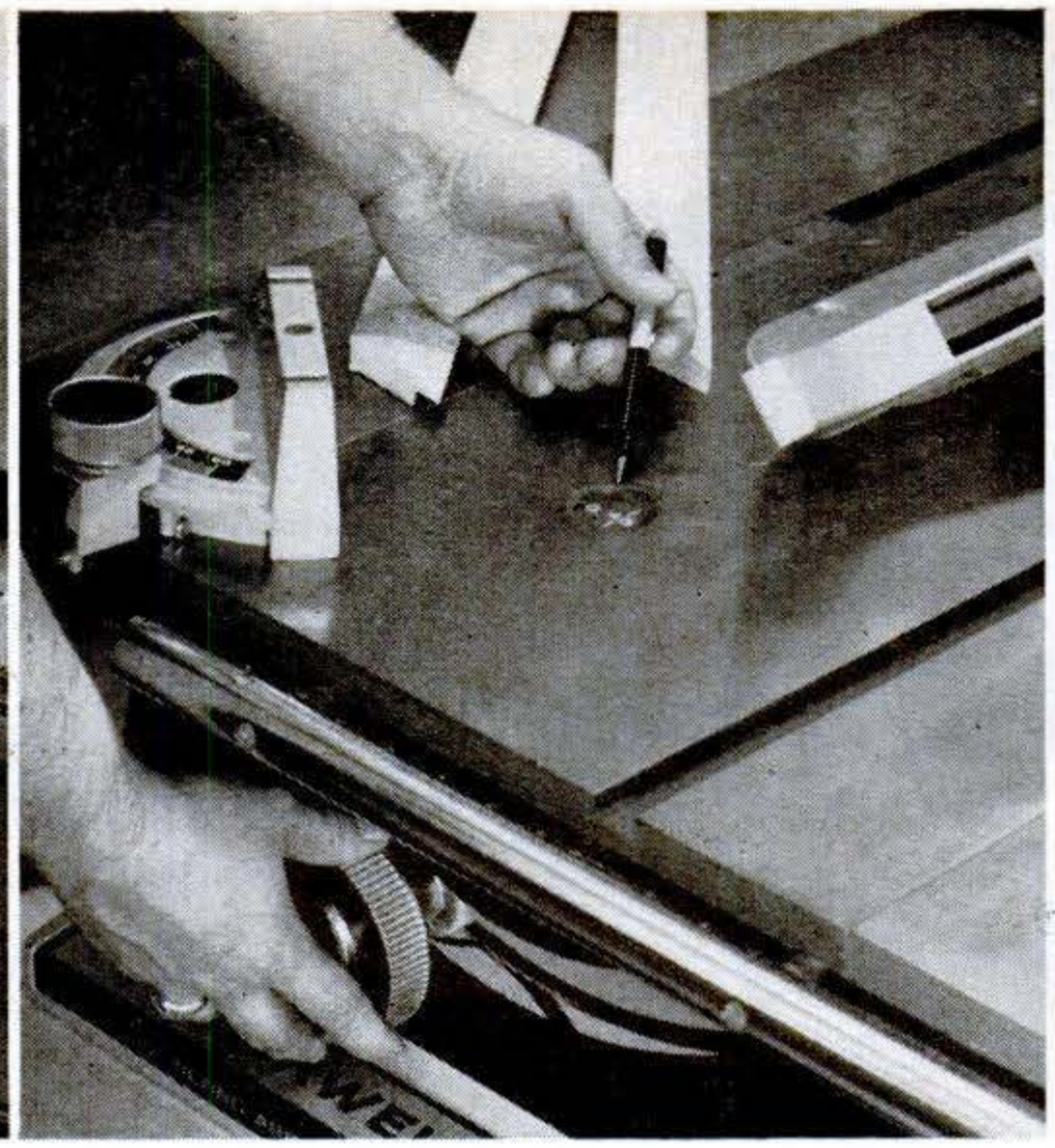
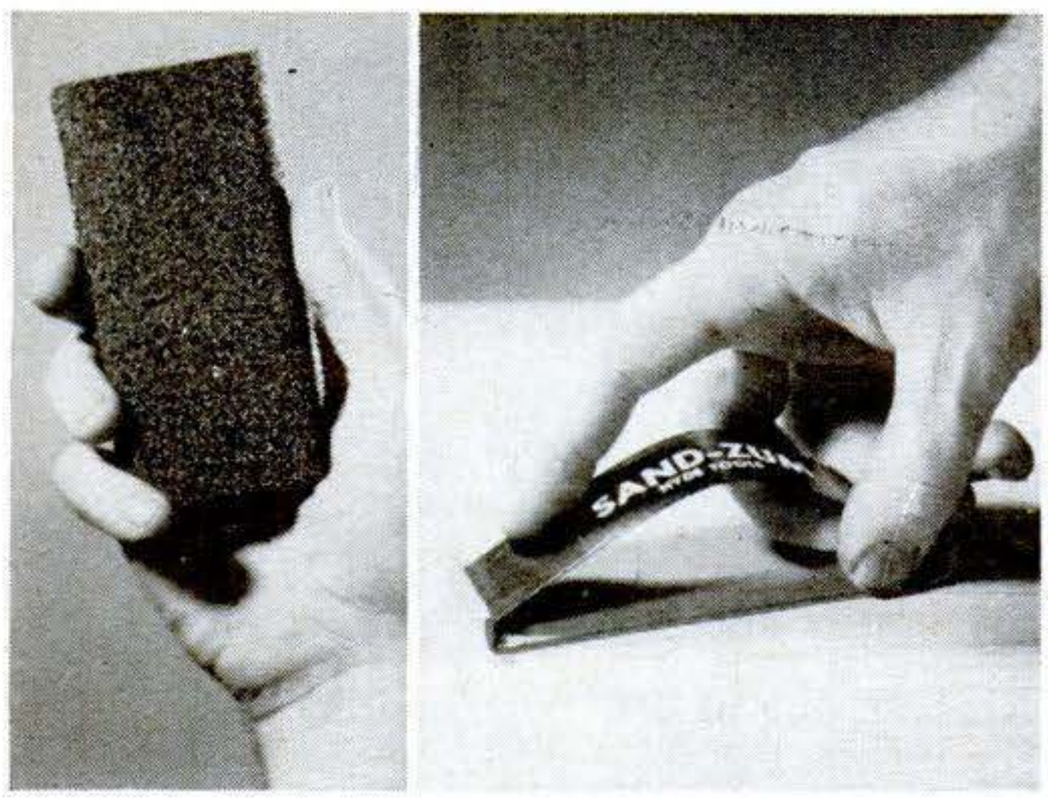
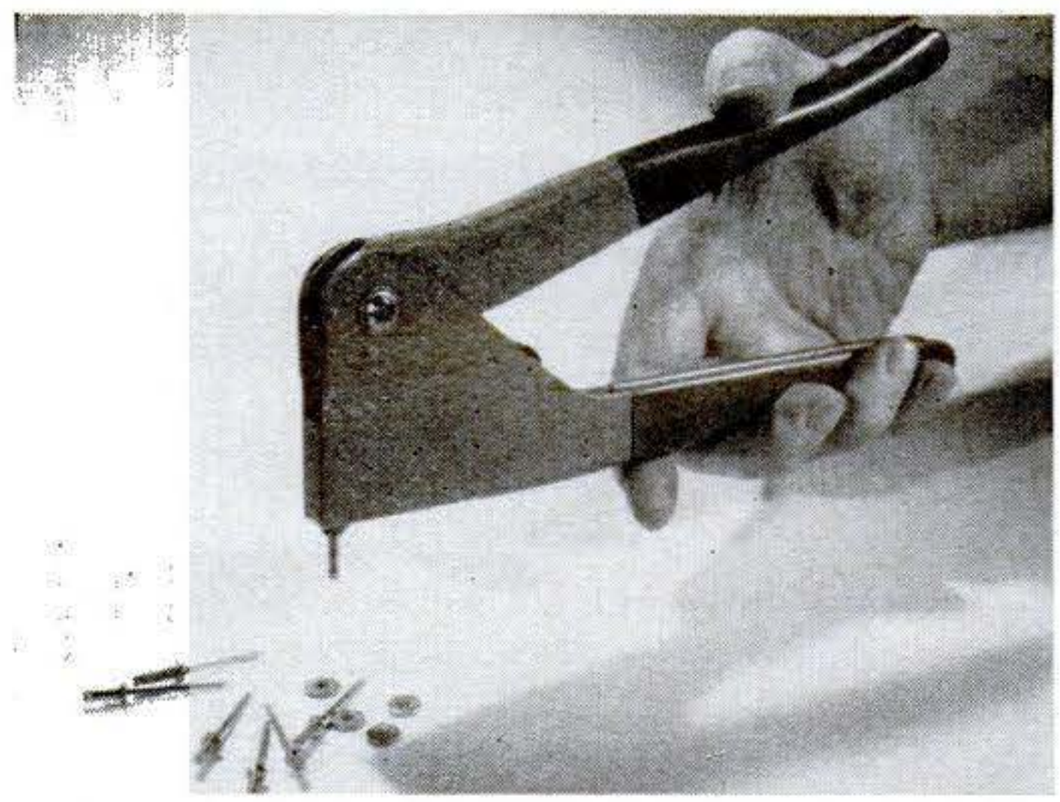


Rip-fence rails swivel back and forth to either side of the blade on a new 10″ Rockwell-Delta table saw, giving a 24″ rip capacity right or left. The rails are switched by loosening one screw and removing another. The table measures 27″ by 36″. A single wheel at the front of the table controls the blade. A handwheel adjusts depth of cut; an outer dial adjusts blade tilt as you read the angle on a table-top bevel scale (photo). The saw is priced at $159.50 with a built-in 1¾-hp. universal motor. Various accessories are available for the saw.



Three small refinishing tools were shown by Hyde Manufacturing Co., Southbridge, Mass.—a new small electric paint remover, its Remove-zum abrasive block, and its Sand-zum hand sander. The paint remover is designed for use on window sills, moldings, and other small areas. The abrasive block has a coarse and fine side. A steel handle holds paper tightly on the sander.



New riveting pliers from Swingline, Inc., will apply rivets even when only one side of the work is accessible. A swivel head takes whichever of three diameters of aluminum or steel rivets the job requires: ⅛″, 5/32″, or 3/16″. Prices are $3.95 or $4.95, depending on the finish.

An economy line of soldering kits was shown by Weller Electric. Included were a 25-watt soldering iron in a re-usable vinyl hanger pouch for $2.98 (the iron plus solder, three extra tips, a solder aid tool, and instructions for $4.44) and four other new irons—40-watt lightweight duty, 80-watt medium duty, 120-watt heavy duty, and 175-watt extra heavy duty. Weller, the company that developed the soldering gun, also showed these quick-heat guns in gift packs.

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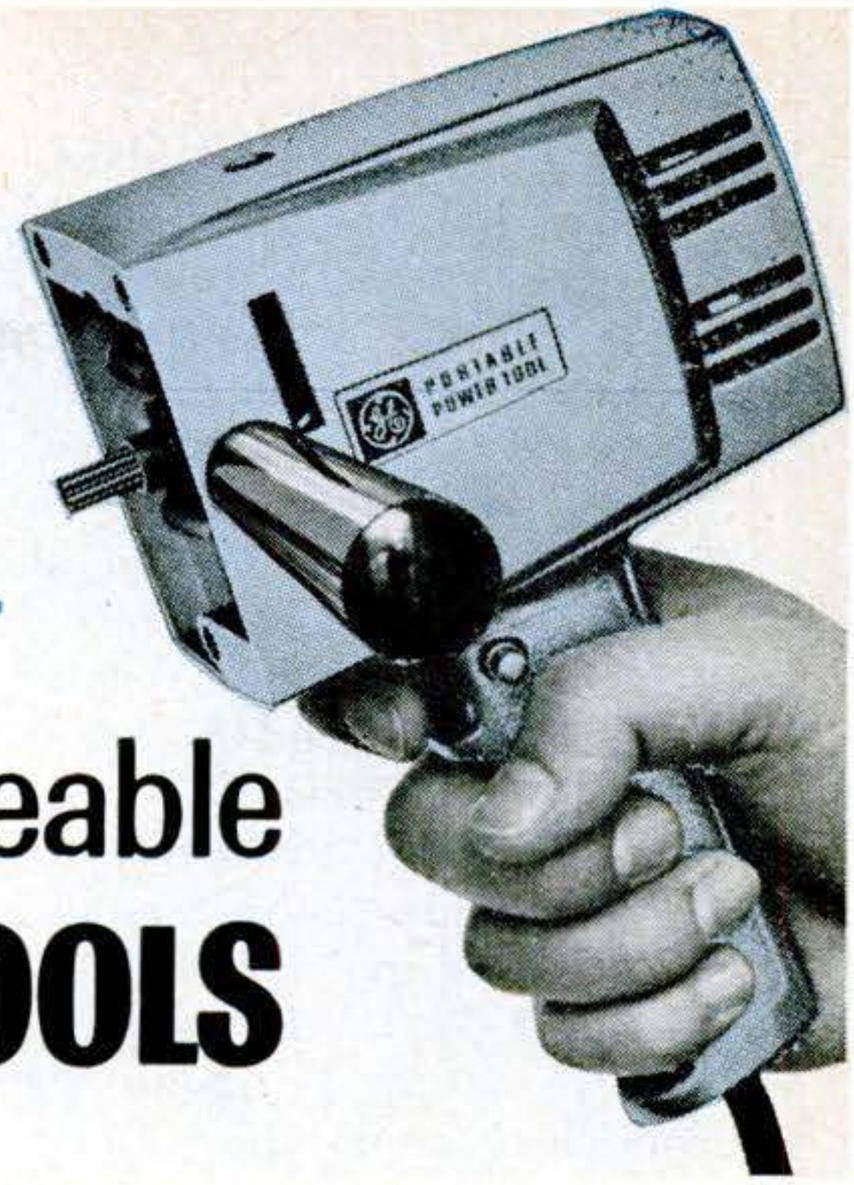

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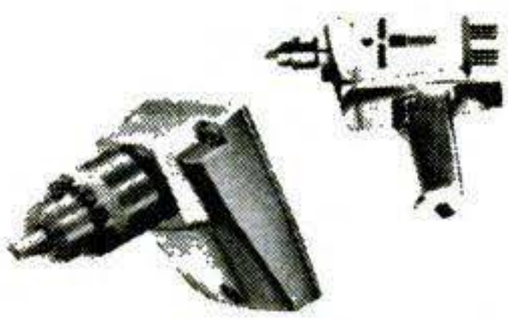

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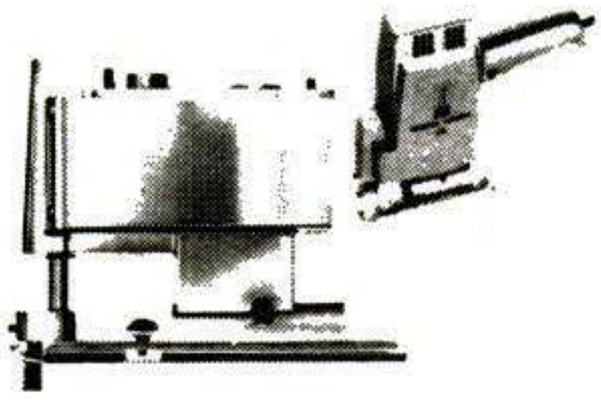

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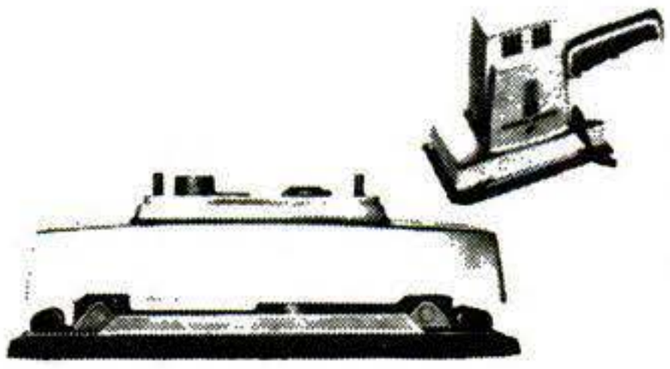

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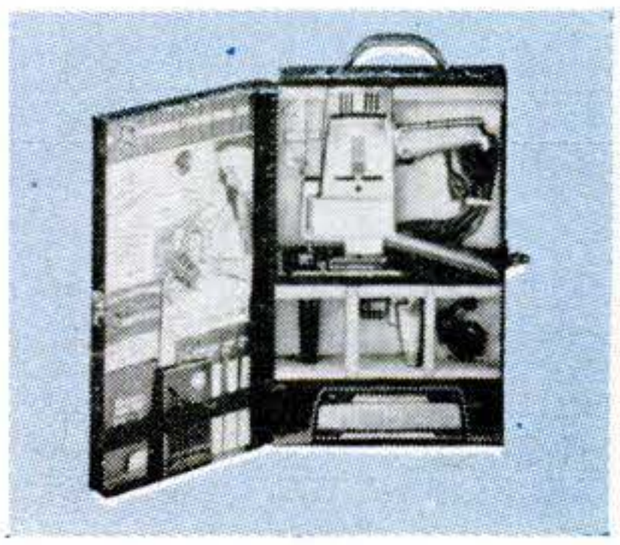

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[Continued from page 92]

ticularly promising is called the Augmented Lunar Module (ALM). It applies the fact that the Saturn V launch vehicle seems capable of hurling toward the moon a somewhat higher payload than was originally specified. This would allow some increase in the propellant capacity of the LM and, in turn, an increase in the useful load landed by the LM. Thus the life support for the astronauts—oxygen, water, food—could be extended for several days. More scientific equipment could be carried along to make those extra days worthwhile.

The other concept envisions twin landings on the moon, by an "LM Shelter" and an "LM Taxi." It would work as follows:

Two Saturn V/Apollo space vehicles are launched from the Cape, maybe weeks apart. The first carries a normal Apollo Command and Service Module and the usual crew of three. Upon arriving in orbit around the moon, the crew detaches and dispatches a special unmanned LM—the LM Shelter—to a predetermined landing spot, and returns to earth.

A home on moon. This one-way LM Shelter consists of an unmodified LM descent stage, and an LM ascent stage from which the propulsion system has been removed. Hence it can land a payload equal to the full weight of a fueled and manned LM ascent stage (plus whatever weight a round-trip LM would leave on the moon).

A few weeks later, the second Apollo spacecraft appears in orbit around the moon. Two of its three astronauts transfer from the Command Module to the LM Taxi and descend to the lunar surface. The LM Taxi differs from a normal LM only in that it can survive the lunar environment for an extended time, without losing its capability of climbing back to the orbit around the moon.

Guided by a radio beacon on the LM Shelter, the LM Taxi touches down within a fraction of a mile from it. Then the Shelter becomes the astronauts' lunar base. They return to the Taxi to depart.

A major attraction of the Shelter-Taxi concept is that the Shelter offers a habitable abode for a stay of weeks. Removing the ascent stage's propulsion system leaves room for the astronauts to sleep in hammocks, for instance, rather than rest in the rather awkward squatting position required in a normal LM. They would be able to get out of their space suits during rest periods. The feasibility of such a stay was illustrated early this year by a simulated moon mission of comparable length. In a cabin about the size of three telephone booths, built for the trial at Minneapolis by Honeywell, Inc., two Marshall Space Flight Center engineers successfully lived and worked for 18 days, making space-suited excursions from time to time. Results of the test were equally applicable to the LM Shelter, or to a mobile and enclosed lunar laboratory (which the design represented).

Another advantage of the one-way LM Shelter, with its great extra payload, is that it can bring along a "Lunar Jeep." This vehicle would extend the astronauts' radius of action from one or two miles to easily 10 times as far.

An obvious disadvantage is that the Shelter-Taxi concept requires two successful landings at the same spot—while the Augmented LM provides a complete, if severely limited, scientific capability wherever it touches down. Views of lunar-surface features from Lunar Orbiter are expected to yield information that will help in choosing between the two approaches.

The next steps. In the long haul, lunar-surface exploration will call for more-advanced hardware, not included in the present Apollo program. For instance, if a Saturn V is employed solely to carry cargo on a one-way trip, to a predetermined spot on the moon, neither the manned Apollo Command and Service Module nor an LM is needed. Instead, the unmanned flight could follow the successful Surveyor soft-landing pattern, with a newly developed high-energy braking system used for the final letdown. Such a transportation system could soft-land payloads of up to 30,000 pounds on the moon.

This capability, entirely within the reach of a standard Apollo/Saturn V launch rocket, could truly put a new dimension in our lunar-surface activities. Mobile laboratories, capable of trips of several hundred miles across the face of the moon, would become a possibility. And permanently inhabited camps on the moon, comparable to our research camps in Antarctica, could become a reality within a few years after the first lunar landing. PS

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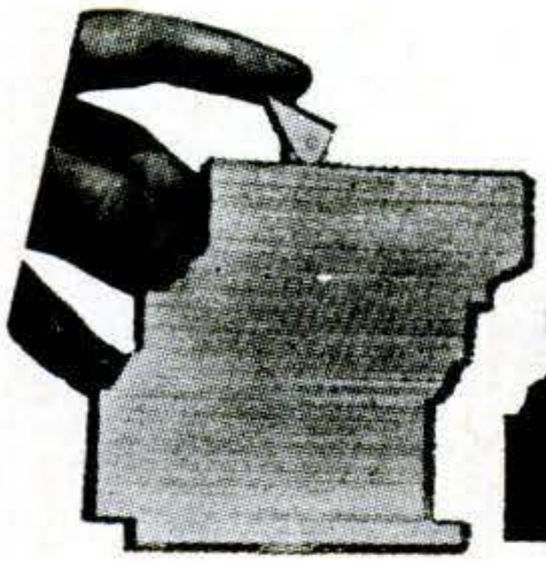

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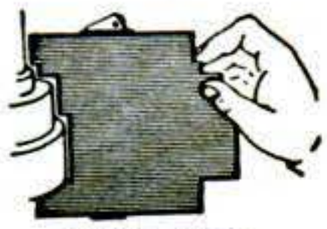

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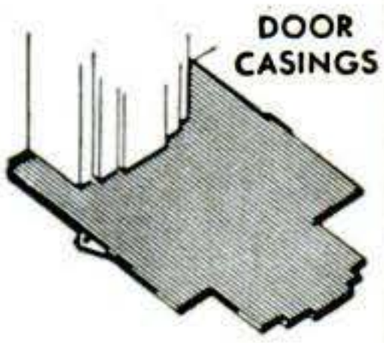

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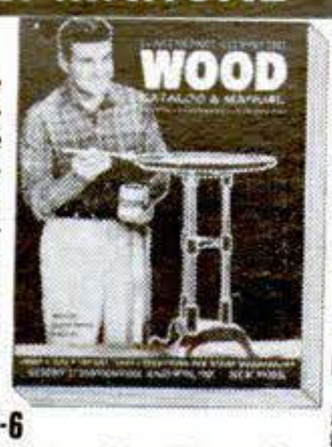

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Guide to Personal Tape Recorders

[*Continued from page 128*]

Three models rank next: the Channel Master 6426, the Panasonic RQ1058, and the VM Charger. Reproduction on all is similar. The VM has a built-in rechargeable battery and charger. Good, crisp voice quality on all three.

Two remaining models—RCA YGS11 and Westinghouse H32R1—don't have the voice quality of the others.

Size-is-no-object machines. No question about it—these machines are the pick of the bunch. Best machine: the Uher 4000-L. It should be, it costs $440—more than twice as much as the nearest runner-up. But it's worth it if you need or want really fine reproduction. Tapes made on the Uher equal or surpass in quality those made on the finest nonportable home machines and many professional recorders, in our judgment.

Even though the sound of the Uher itself is limited by the small speaker, music played back on the machine is surprisingly good. The extremely low distortion and

Concord's model 300 doesn't fall into any of the three catagories, so we tested it on its own. It's a fine machine with a unique feature: Tape can run in either direction so you don't have to flip reels.

balanced sound produce quite listenable music. Played back on an auxiliary amplifier and high-quality speaker, the sound is superb. The Uher, incidentally, was the only machine tested with four speeds—7½, 3¾, 1⅞, and 15/16 inches per second. Even at the extremely slow speed of 15/16 (at this rate, a five-inch reel of half-mil tape gives six hours of listening on each

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side), the sound was astonishingly good.

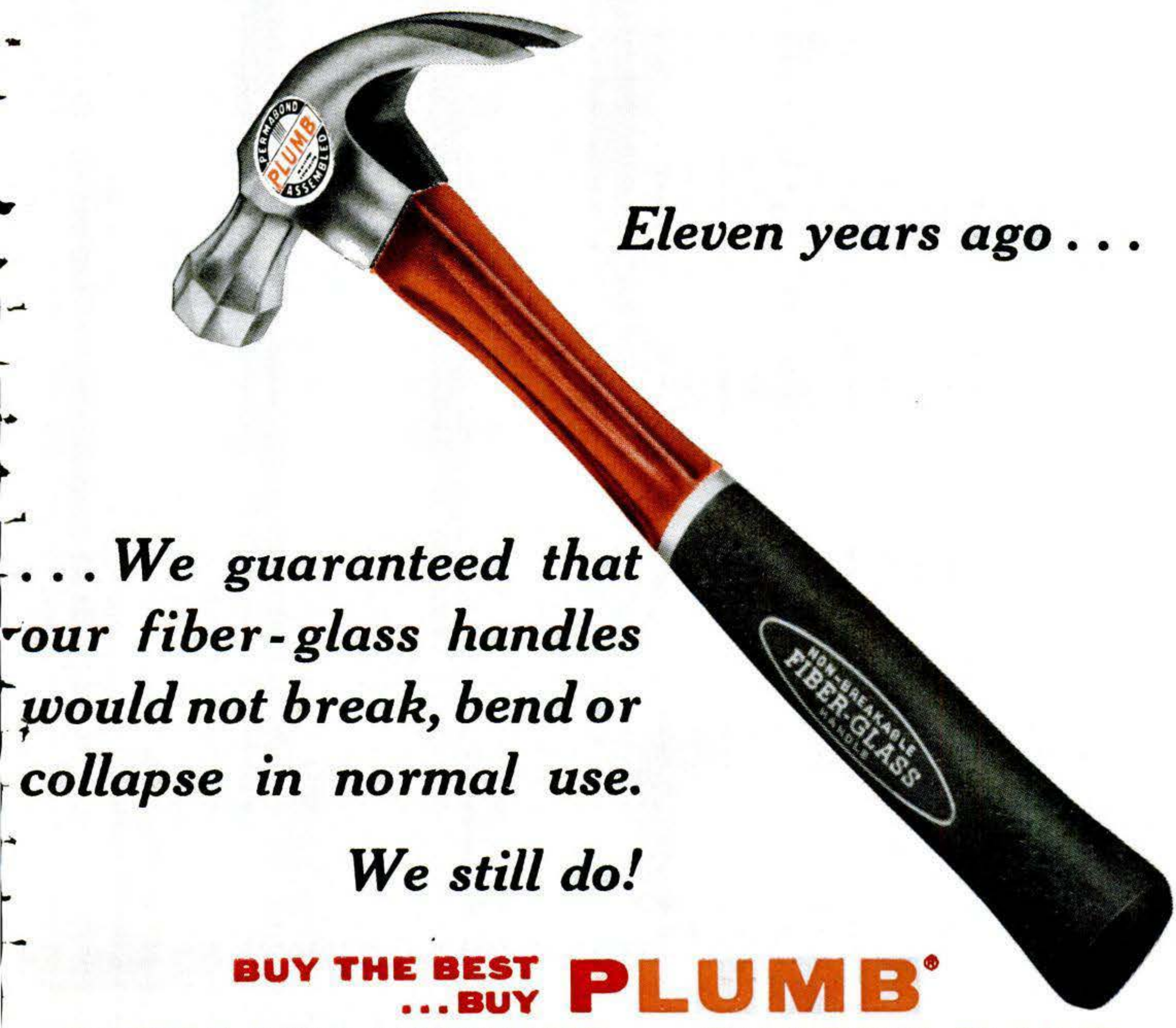
In second place is the Sony 800—an excellent machine well worth the price of $200. As with the Uher, it comes to you with a cardioid—directional—microphone, excellent for reducing background noise since it picks up sound from only one direction. It has AVC with defeat. Largest and heaviest machine tested (12 pounds).

Close behind the Sony is the Telefunken 300. One disadvantage: It runs at only one speed, 3¾ inches per second. Its quality is excellent, however, particularly when played back through a hi-fi amplifier and speaker.

Best buy. Surprising standout of the entire test was the Channel Master 6464. Naturalness of both speech and music, while not up to the three previous machines, was excellent. And at the price—$109.95—it is the best buy.

The Panasonic RQ-152 was good for voice reproduction, not so good for music. It was the lightest of the bunch—less than seven pounds—important if you do a lot of walking and talking.

One machine belongs in a category of its own: the Concord 300. This recorder, which uses four-inch reels, falls between two classes both in size and weight. It has AVC and sounds fine on voice. In addition, it has a unique feature: It runs in both directions. On most machines, when you finish recording on one side of the tape, you flip the reels and record on the other side. With the Concord 300 you flip a lever instead. The tape, which has been going from left to right, now runs at the same speed from right to left. Another set of heads, mounted to record on the bottom half of the tape, is cut into the circuit. PS



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Is It Necessary to Break-In a New Car?

[Continued from page 118]

even curing results in uneven braking power.

Burnishing your brakes means smoothing the face of the brake linings and fitting (by driving) the contour of the lining to the curve of the brake drums.

If you abuse new brakes by harsh usage, heat spotting occurs—the drum overheats. Then chemical change takes place in certain parts of the drum; the iron material is tempered like tool steel. These tempered areas get larger as time goes on, until finally the drums actually crack. If your brakes are only mildly abused, and hot spots remain small, you will get chatter, pull, or other instability.

Brake "glazing," too, can be avoided by proper run-in. Engineers at Kelsey-Hayes say that glazing occurs generally if brakes are continually babied, even after the normal run-in span has ended. They recommend that you go easy on the brakes for the first 500 stops—keep away from tight situations in traffic—then use them without special care. But you'll still be on the safe side if you use the brakes lightly. The men who design your car's stopping power tell me that glazed linings lose no more than five percent of their effective friction.

Should you run-in new tires? Chrysler's owner's manual states (and Chrysler service stubbornly stands by this): "New tires, including the spare, should be broken in for at least 50 miles at speeds of not more than 60 miles per hour."

This is unnecessary. You should run the tires just as if they had a thousand miles on them. Rubber companies say that 10 years ago you had to be careful, but you need not worry about a run-in period with today's products.

There's no doubt that it pays to break-in your new car correctly. Here's a summation of good advice from the experts:

- Avoid sudden starts and stops within the first 400-500 miles.
- Be specially alert to strains on the engine valve train and piston rings and the braking system during this period—the run-in is set up just for them.
- Check tires, belts, and fluids often when the car is new. You can catch a lot of trouble here before it becomes serious.
- Listen for strange noises in the engine and body. They may mean trouble. RS

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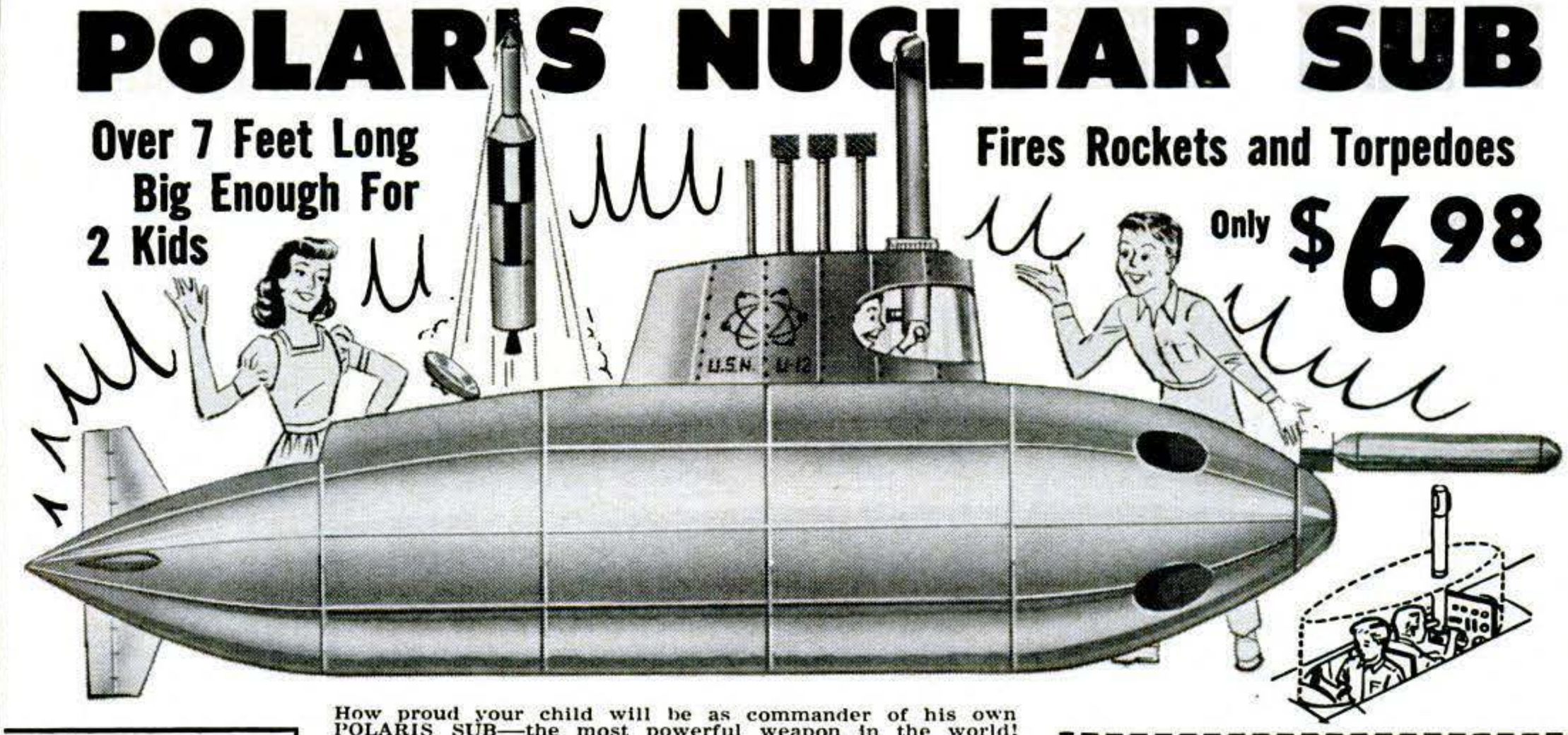

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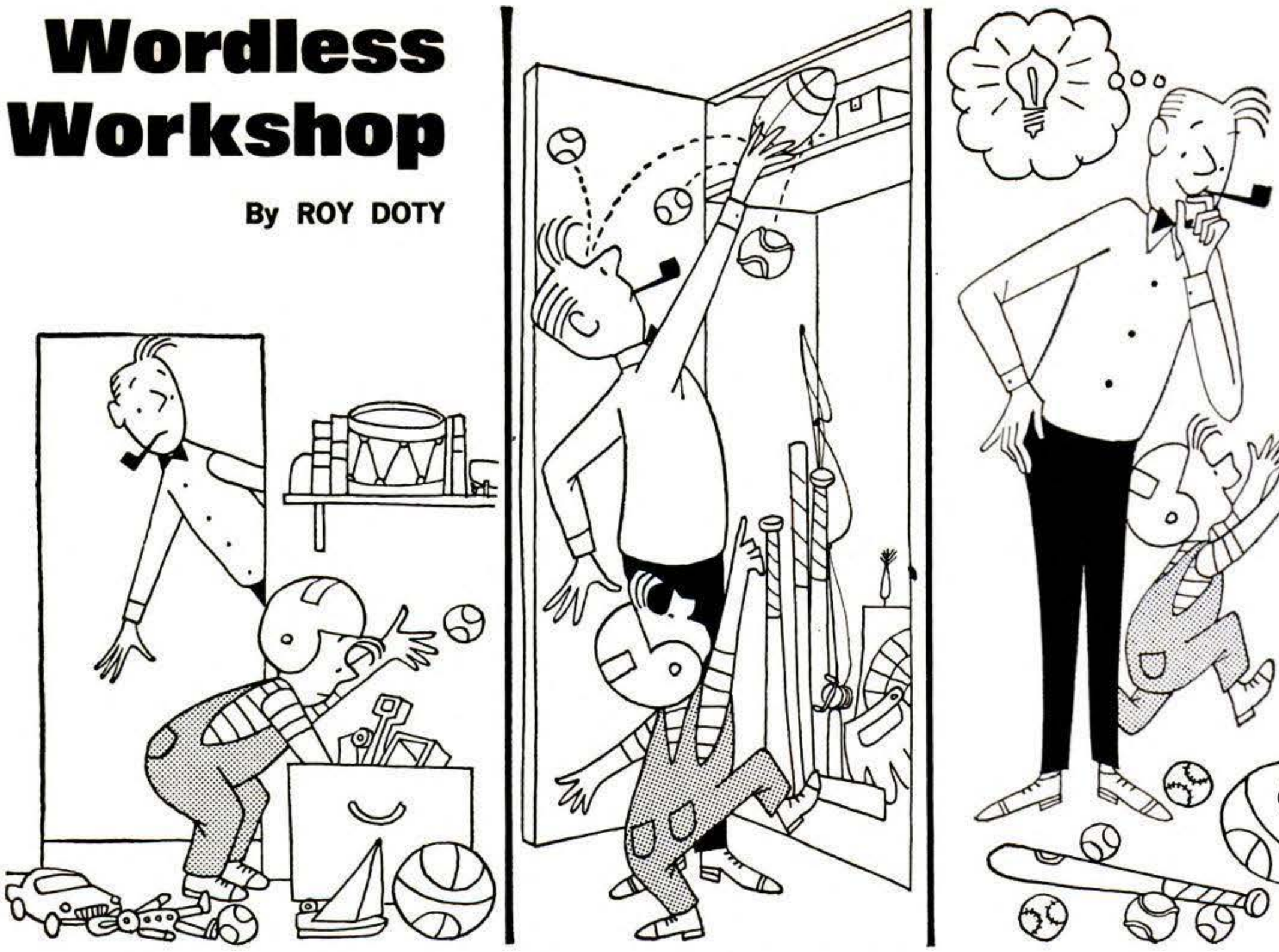
By ROY DOTY



End to end, Stanley has the

Left End
"STEELMASTER"

Left Tackle
"100 PLUS"

Left Guard
"THE SLEDGE"

Center
"RIM TEMPERED"

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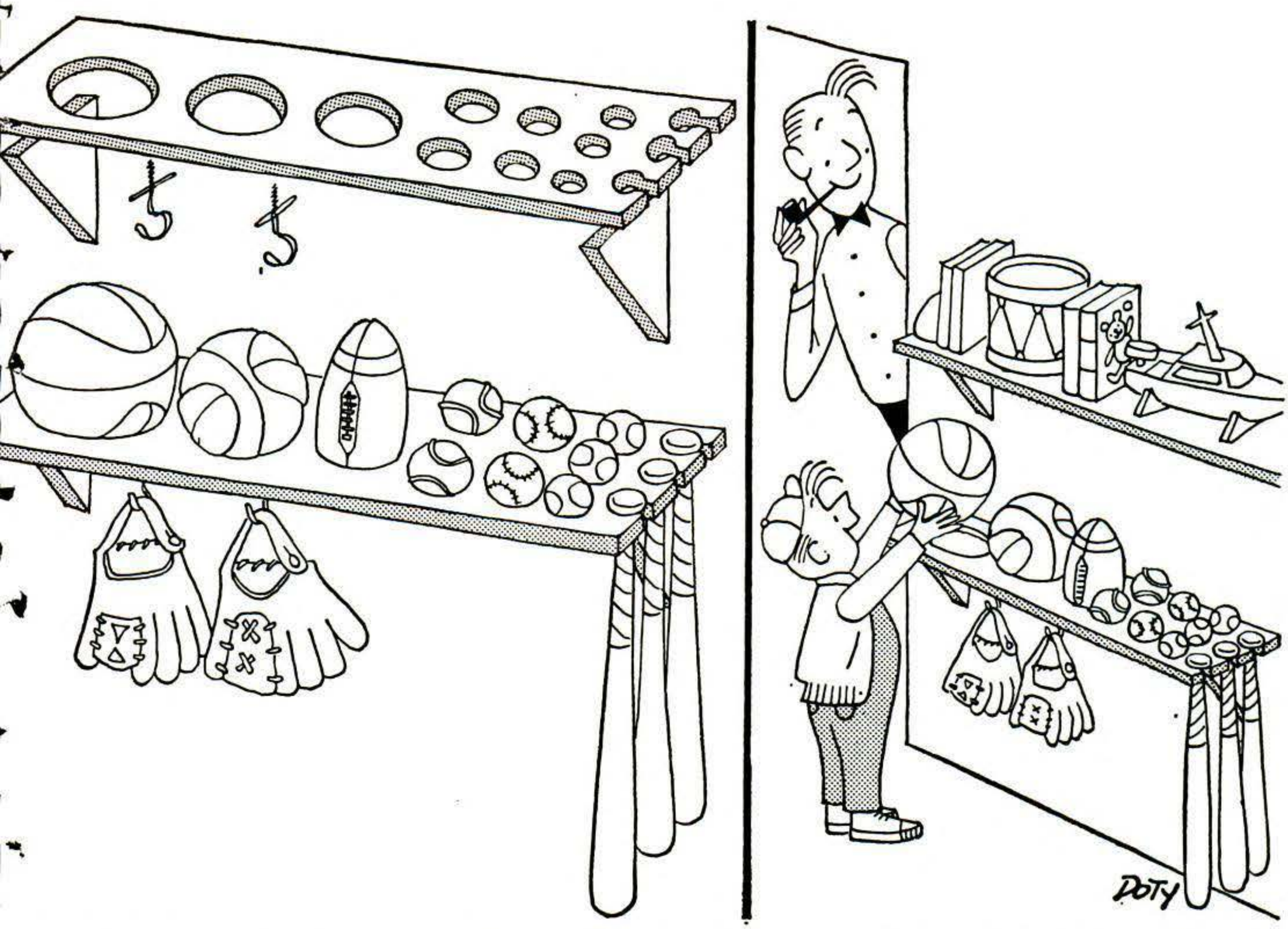

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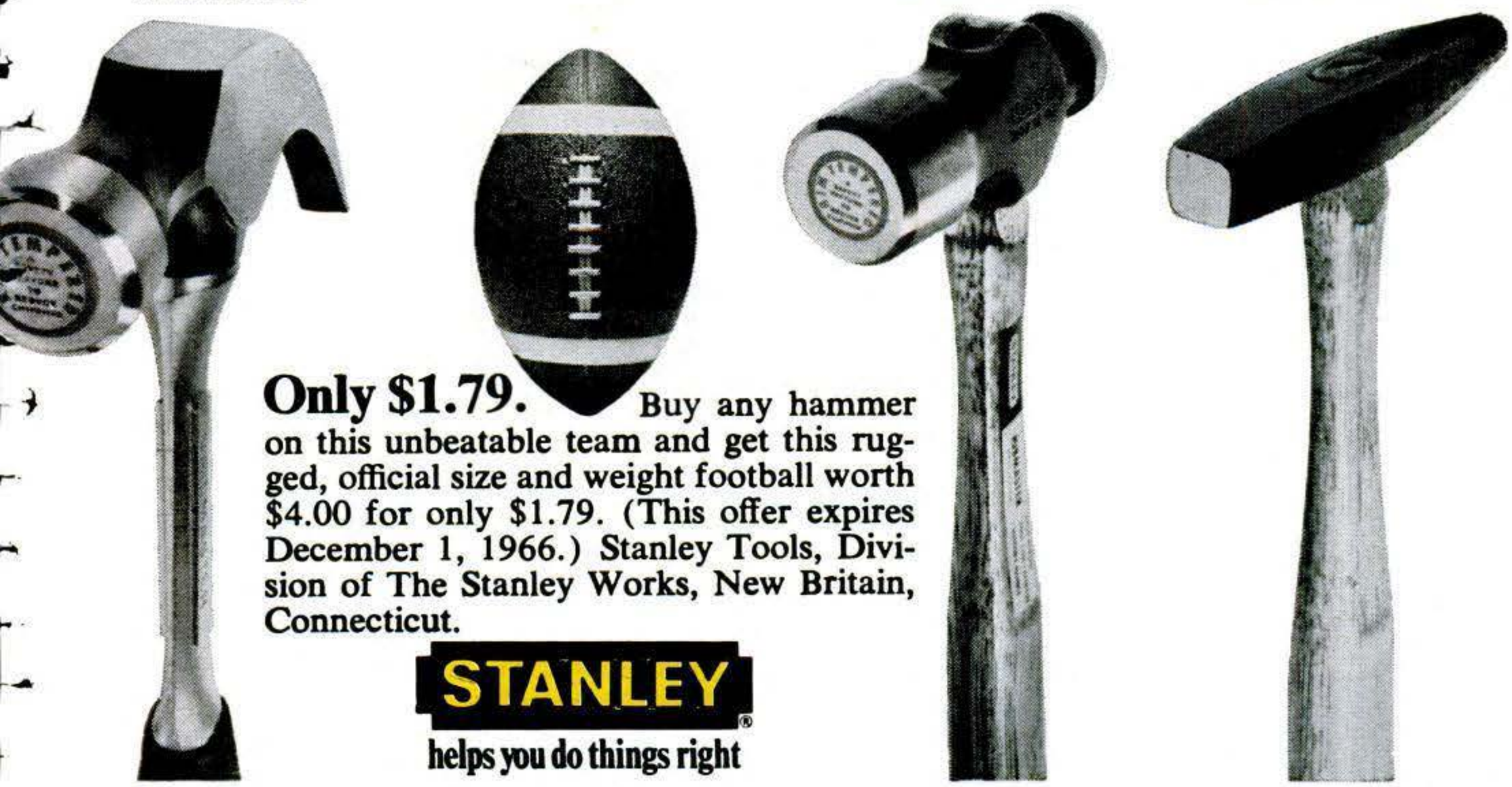

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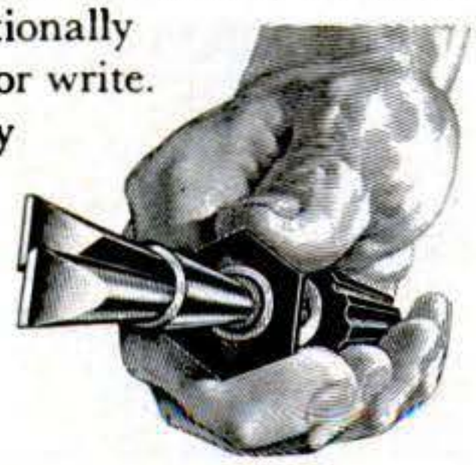

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Salt Lake City, Utah 84110 *©1966 by Kedman Company*

Hunt for the Loch Ness Monster

[*Continued from page 115*]

has ever been reported by any eyewitness.

How did it get into Loch Ness? From the sea, all say. Until the end of the last Ice Age, this body of water was an arm of the sea. Then the ice on the craggy rocks melted—and the earth's crust, relieved of this burden, rose and isolated Loch Ness from the sea.

Many thousands of years ago, ocean creatures had easy access to Loch Ness. Some may have liked it and settled down. The murky isolated depths of the loch, well stocked with fish, could provide an ideal sanctuary for a colony of monsters. With their basic needs satisfied, they could make themselves at home and breed, like the coelacanth. Adaptation to the gradual change from a salt-water to a fresh-water environment would have been quite possible, and Nessie could have become indigenous to the landlocked lake.

Today the surface of Loch Ness is 50 feet above sea level. Its sole link with the sea is the silted-up River Ness, only 18 inches deep, at the northern end.

Wedged between steep pine-clad hills of exceptional beauty that rise to 1,800 feet, Loch Ness is 24 miles long and one to 1½ miles wide. It has a maximum depth of 754 feet, and more than half goes down 700 feet. The water never freezes, and remains at near-constant temperature throughout the year—a steady 42 degrees at the flat muddy bottom. Marine life is plentiful—salmon up to 30 pounds, 15-pound trout, eels, pike. It adds up to a haven for the elusive giant.

The year of the shock waves. While legends of monsters go back centuries, the first credible reports began in 1933. In that year, a road along the lake from Inverness to Fort Augustus was blasted out of the rock. Perhaps the shock waves disturbed the creatures, for many sightings were reported in the following months.

At Fort Augustus I met one of the earliest and certainly most reliable witnesses—Alex Campbell, Water Bailiff of Loch Ness in charge of trout and salmon hatcheries. His first view of Nessie was in May, 1934.

"A flat reptilian head on a swanlike neck towered six feet over the water," he told me. "A humped black body stretched a full 30 feet behind. The head flicked nervously from side to side, as a couple of

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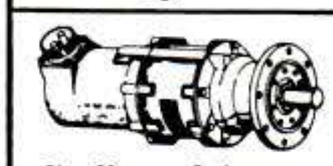

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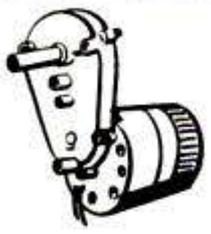

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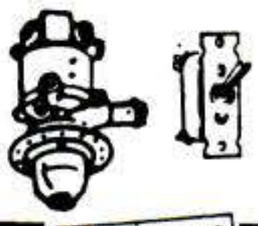

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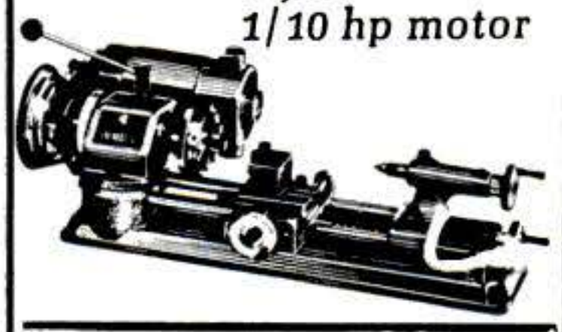
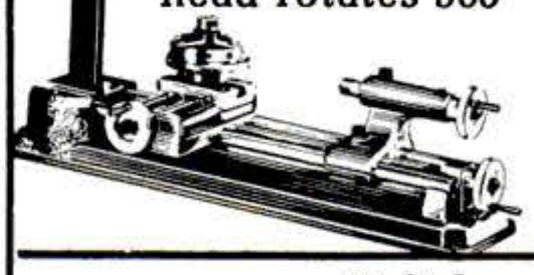


Drill press head rotates 360°



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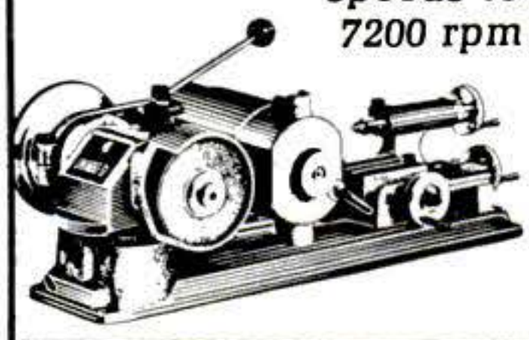

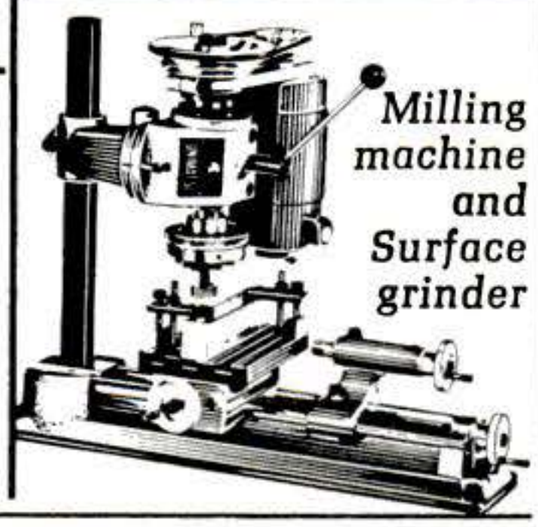

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Hunt for the Loch Ness Monster

herring trawlers approached, and then ducked under the water and disappeared." Since then, Campbell has seen the animal many times, most recently in August, 1964.

Tim Dinsdale sifts the reports of 100 eyewitnesses in his book, *Loch Ness Monster.* They make astonishing reading:

"Three humps churning through the water leaving a foaming trail . . . Head about the same width as neck, mouth 12 to 18 inches wide . . . Looked like an elephant's back, four feet wide, 12 feet long . . . Wake like from a torpedo . . . Speed about 35 m.p.h. . ."

Except for the number of humps, the descriptions are remarkably consistent. Most sightings occur between dawn and 9:30 a.m. The creatures, probably several of them, have been seen in all parts of the lake. About all that is known of their behavior is their apparent fear of noise—they submerge at the sound of a motorboat.

A posse for Nessie. Currently the quest is spearheaded by the enthusiasts of the Loch Ness Phenomena Investigation Bureau, whose directors now include an associate professor of biochemistry at the University of Chicago. This year's five-month LNPIB expedition to Loch Ness, placing camera posts all around the lake, is the fifth it has conducted.

A crew of nine, recruited from all over England for a week or two at a time, man the four house trailers that serve as observation posts. All are volunteers, sleeping in the trailers and cooking their own meals—and paying for the privilege.

Headquarters is on a grassy bank near Drumnadrochit, where Clem Skelton, who has converted one trailer into a darkroom, gets up at 4:30 a.m. to man the main camera battery. Four cameras are taken to other vantage points on the lake each morning. Score to date is only a few long-range photos showing little detail—but 38 sightings, and hundreds of eyewitness reports from others in the area.

Photos first. Initial LNPIB goal is to obtain photographs convincing enough to prod moneyed organizations into backing a more ambitious search with electronic detecting and tracking equipment. "We're after the rarest creature on earth, an exciting scientific mystery," David James told me, "but we're working on a shoestring." The LNPIB is financed entirely by volun-

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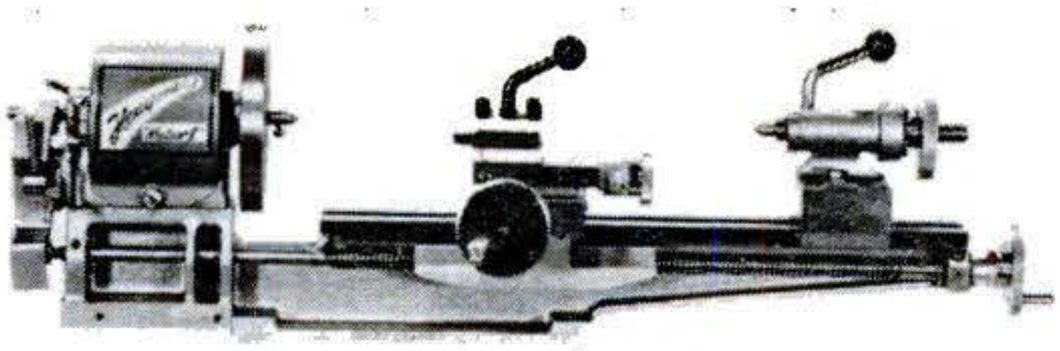

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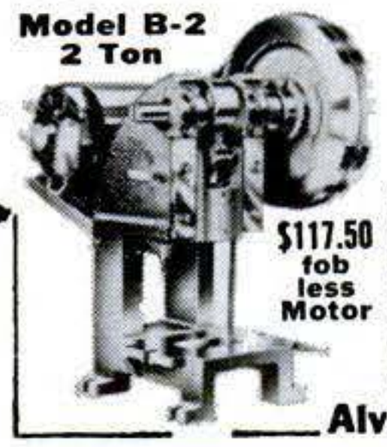

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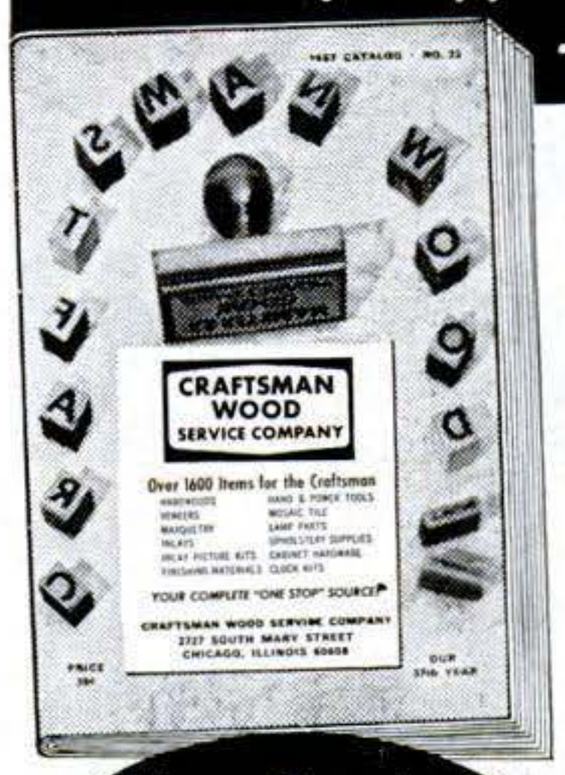

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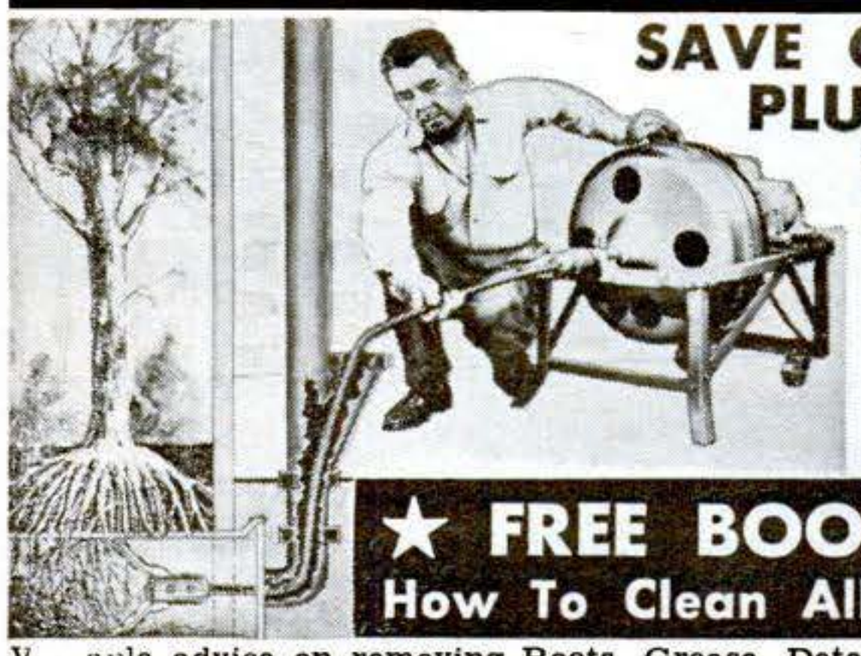

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Hunt for the Loch Ness Monster

tary contributions; one of the largest, $5,000, was subscribed this year.

A search by divers would be unrewarding—light penetrates only a few feet in the peat-stained, tea-colored water. It might be dangerous, too, since the creature is thought to be carnivorous.

Whether a people-eater or not, shy Nessie the Monster seems assured of tender loving care. Shooting or trapping it is strictly out—the LNPIB is determined to safeguard what might be the last few survivors of an almost-extinct race.

Radar and sonar next? Tracking Nessie's movements with radar and echo-sounding gear promises the best way to study it, the group holds. Ultimate LNPIB aim is a permanent observation station at Loch Ness using scientific aids like these, and costing perhaps $80,000 to equip.

For surface observation, a single radar set at one end of the long straight lake could scan the entire length of the water. It would be employed at night when few boats are about, and when the monster is believed to make frequent appearances under cover of darkness. Radar tracking, perhaps coupled with infrared photography, could reveal its nocturnal habits.

For underwater tracking, echo-sounding could serve. It was tried in 1960, with inconclusive results, by an Oxford and Cambridge University expedition using a motorboat and a borrowed fish-finder. One recorded trace showed a large unidentified object 240 feet down, but not on the bottom. It then disappeared and was lost. If it was the monster, it may have fled the sound of the boat's engine and propeller. Now there's talk of sonar-tracking the creature from a silent sailboat.

One proposed experiment would plant sonar gear of variable frequency on the lake bottom. If vibrations of certain ultrasonic frequencies repel the animal, as some suspect, they might gently shoo it to the surface for observation and photography. And the frequency found least disturbing would then be used for underwater search.

In such ways, says the LNPIB, it should finally be possible to identify the species, find out how many there are, learn their habits, and protect and preserve them. Scientists could then study their physiology and origins. It would be a dramatic new chapter in natural history. PS

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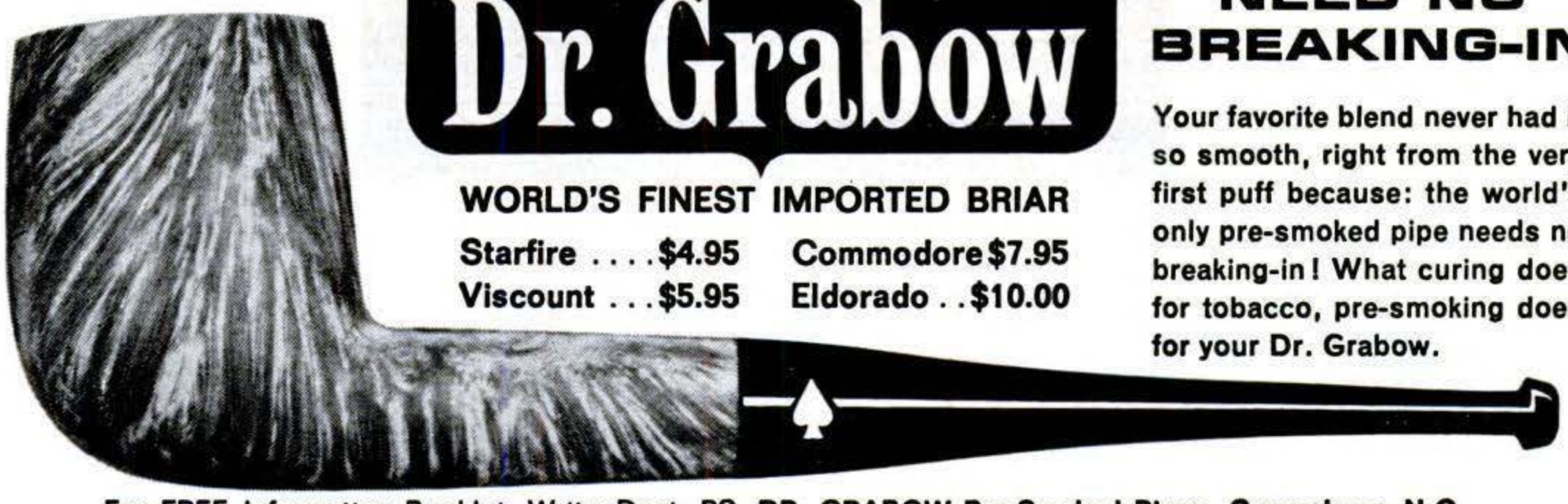

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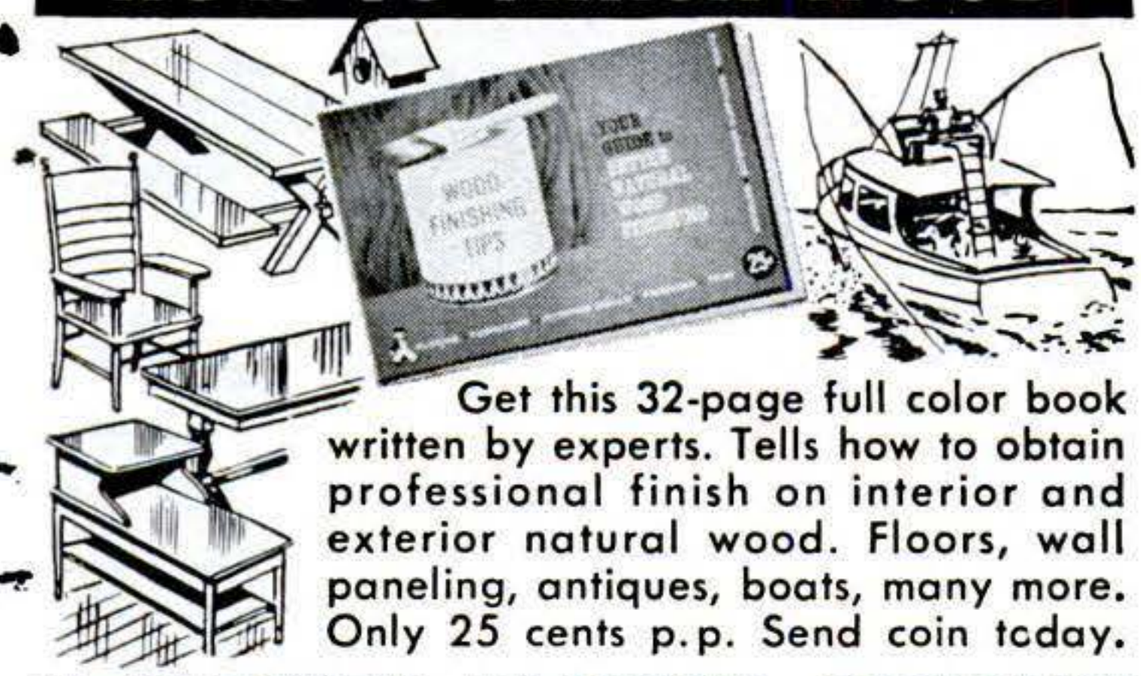

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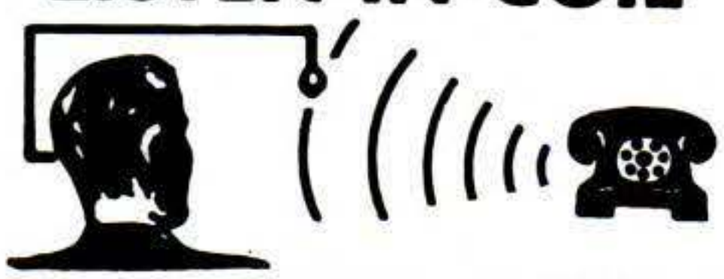

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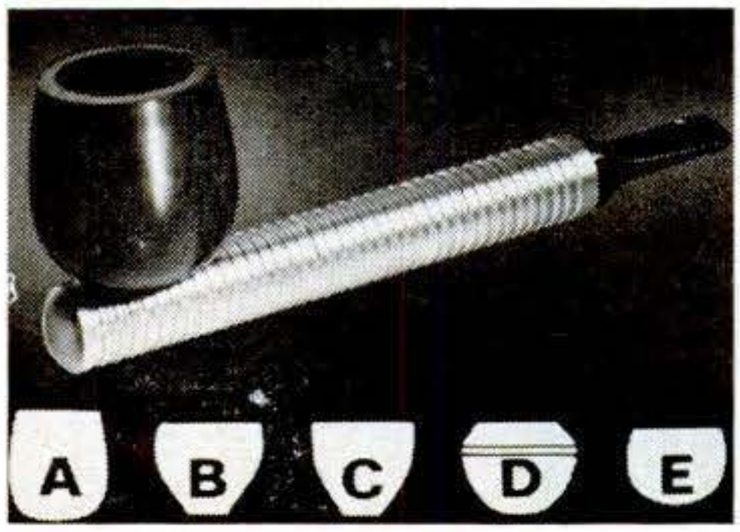

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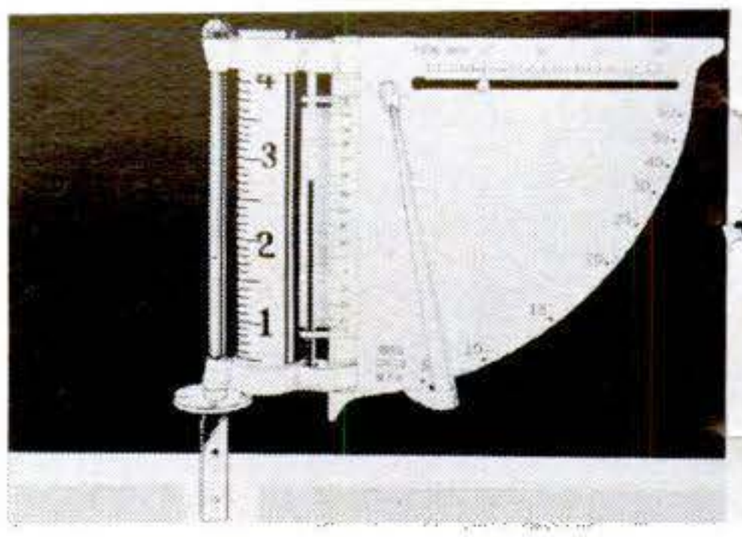

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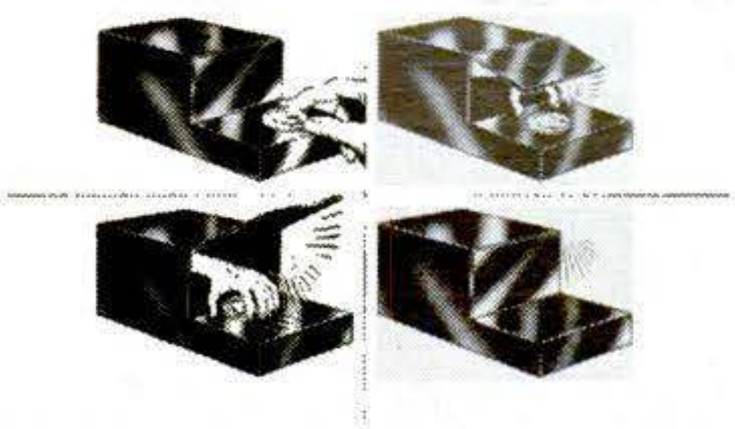

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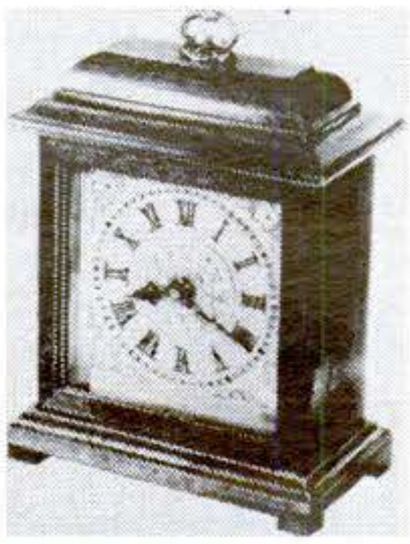

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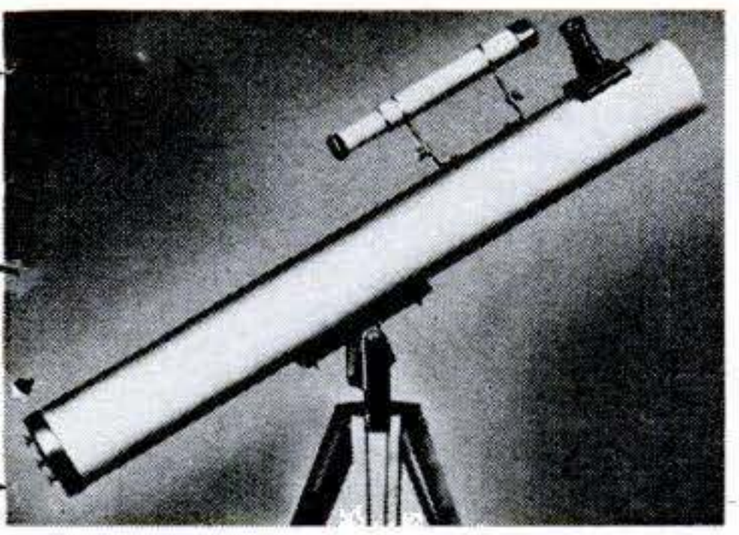

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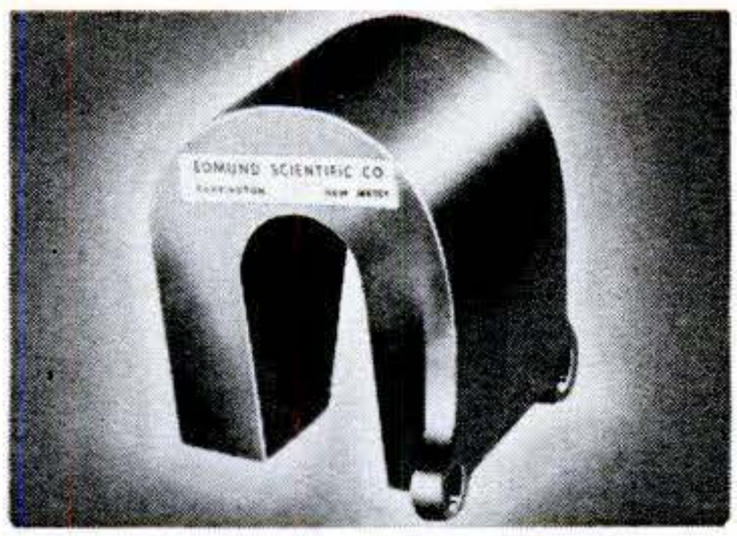

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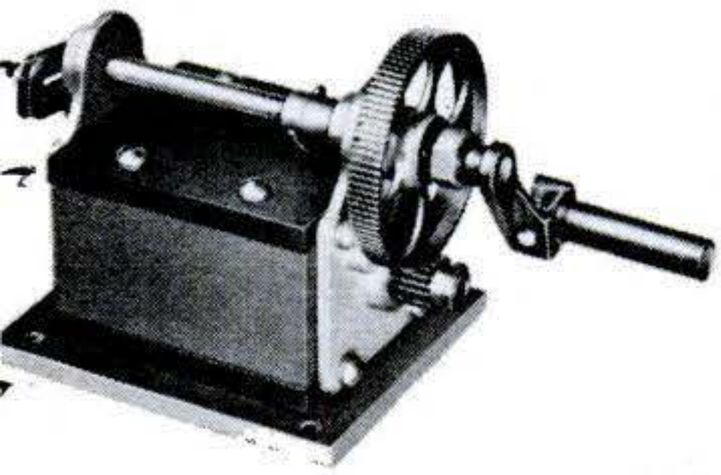

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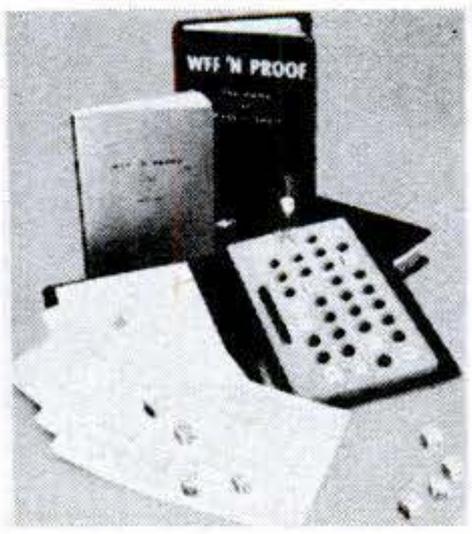

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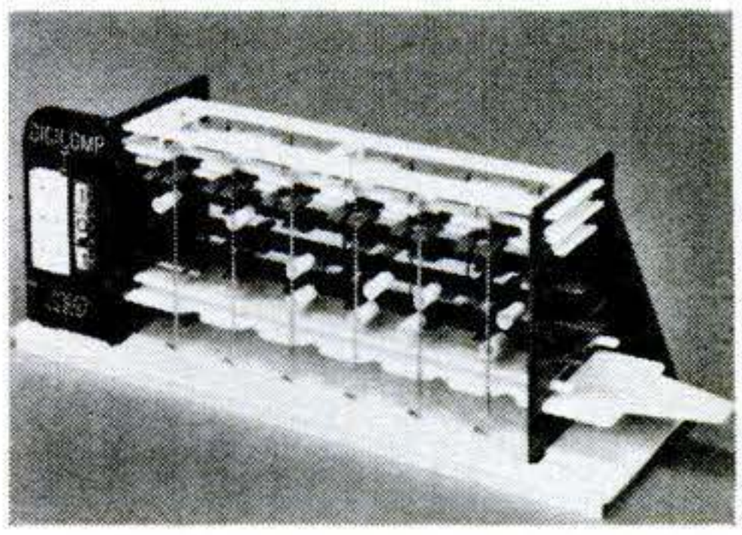

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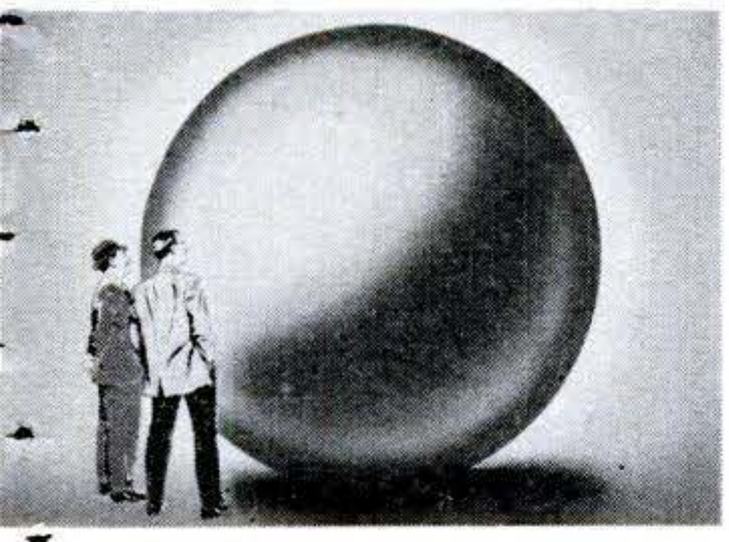

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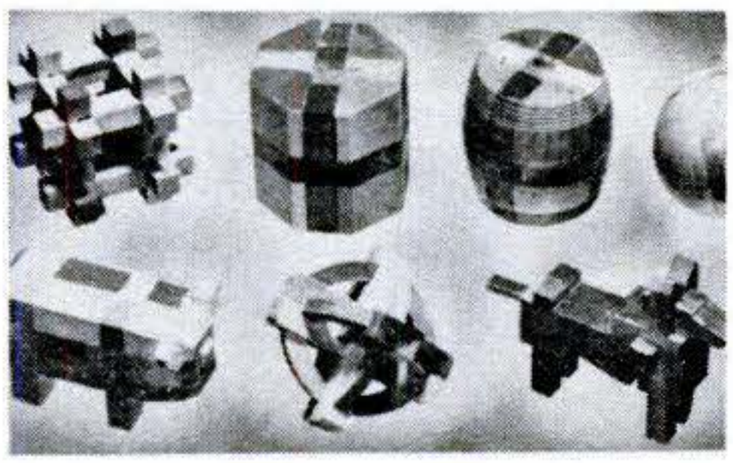

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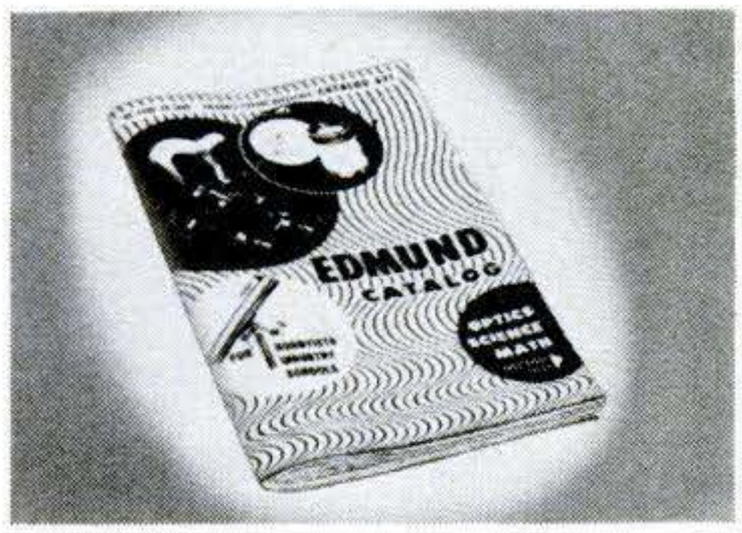

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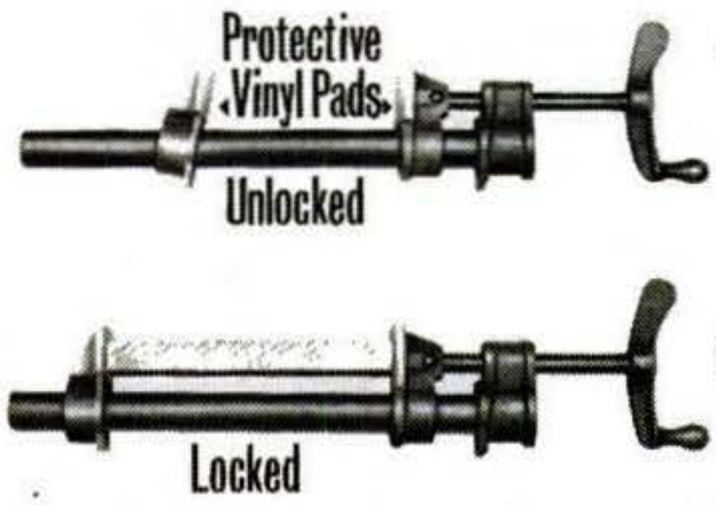

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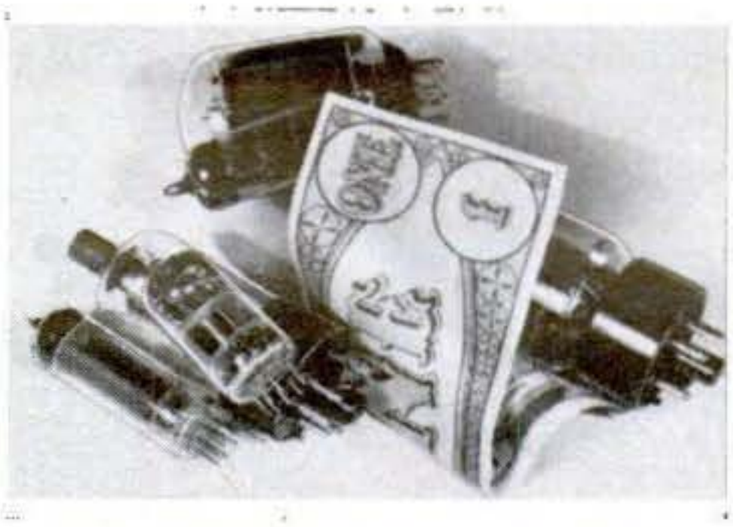

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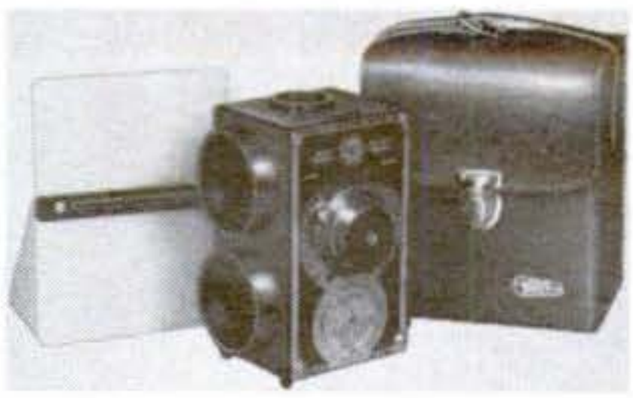

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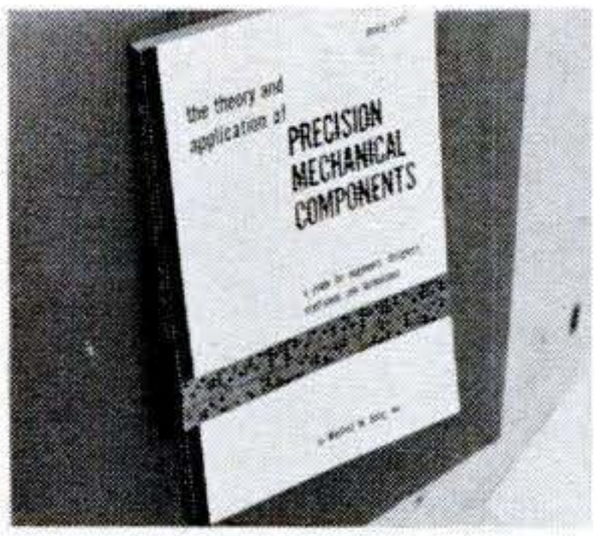

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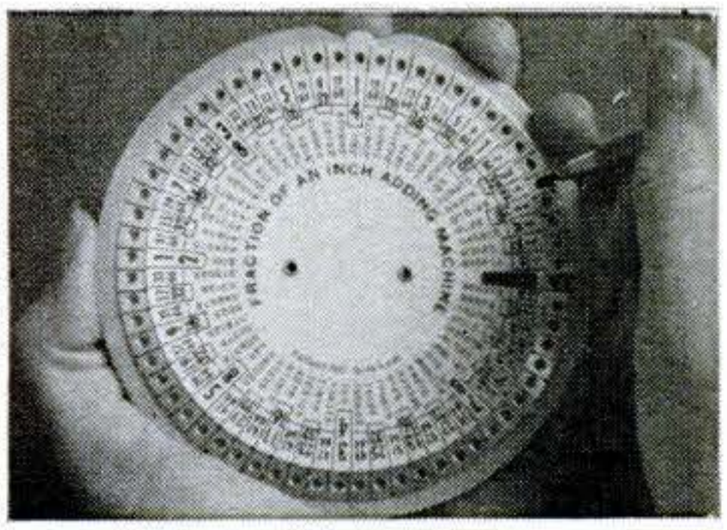

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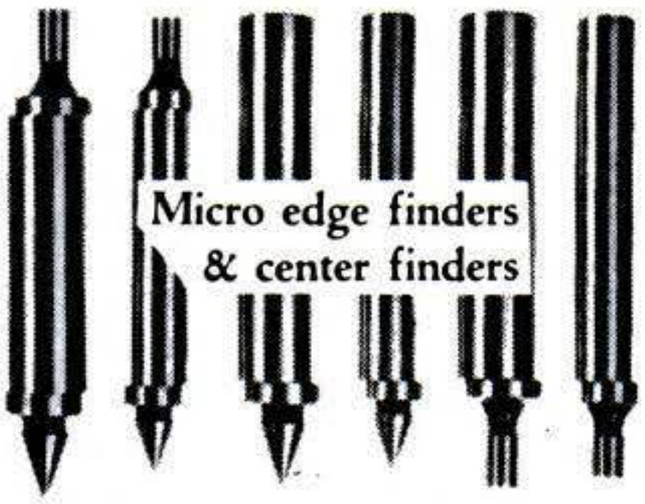

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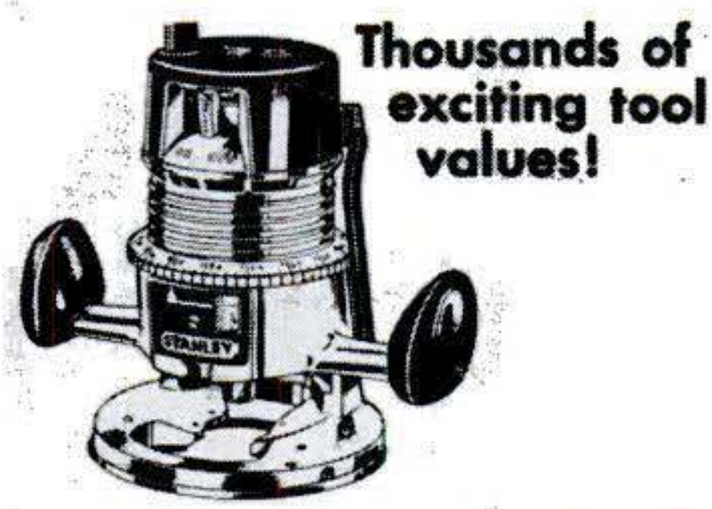

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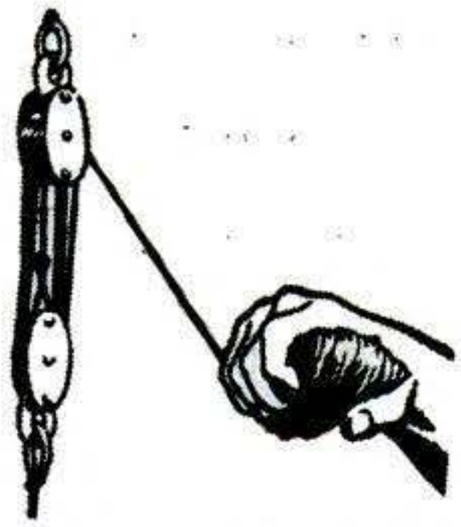

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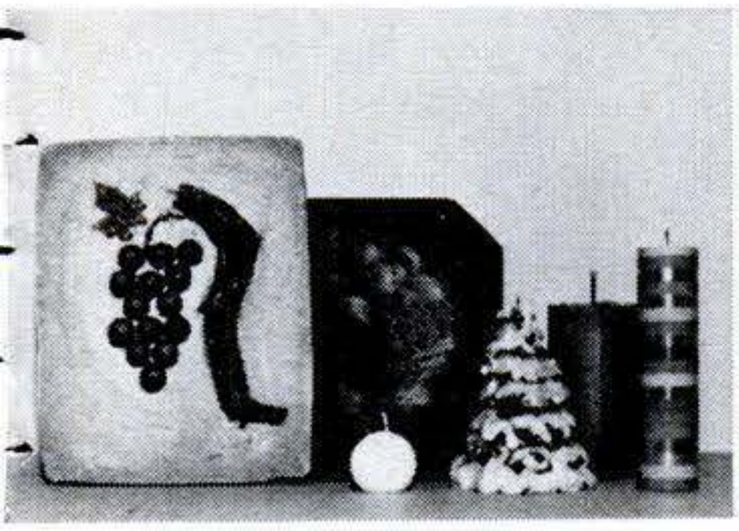

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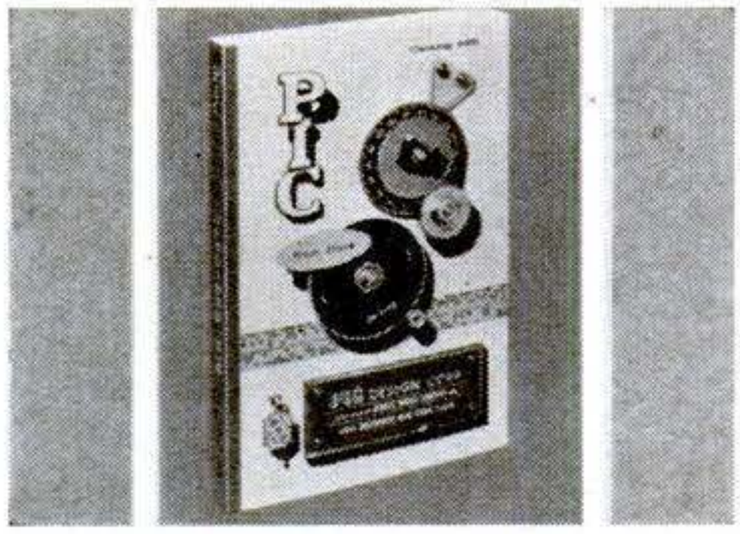

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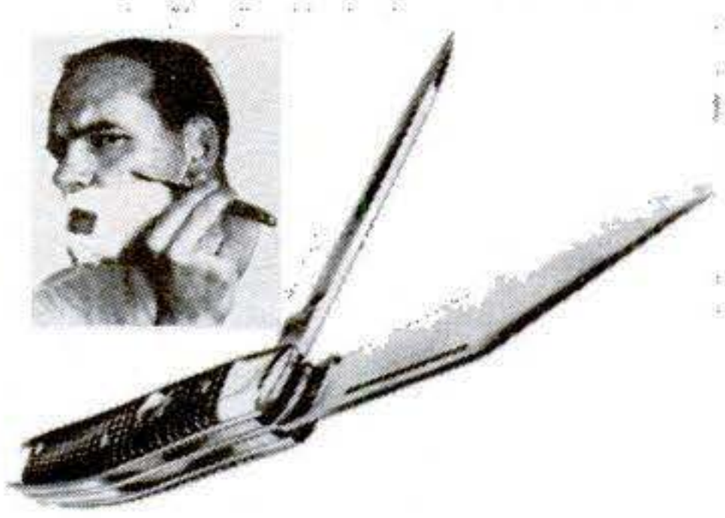

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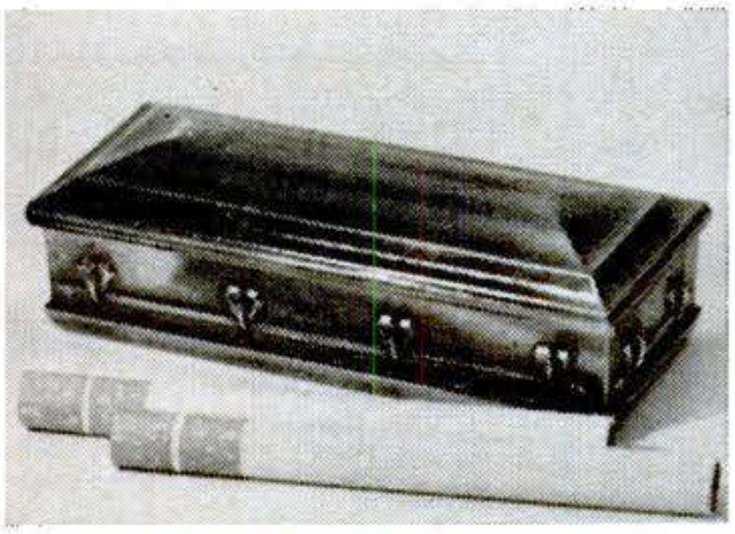

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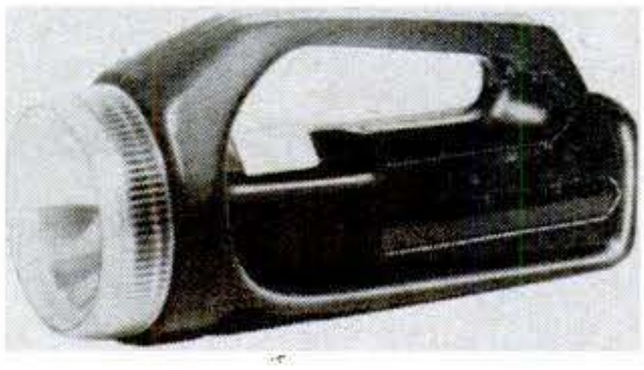

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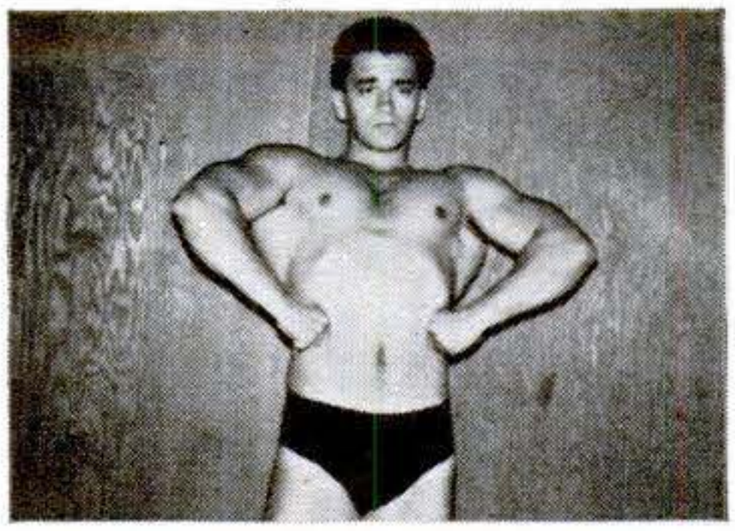

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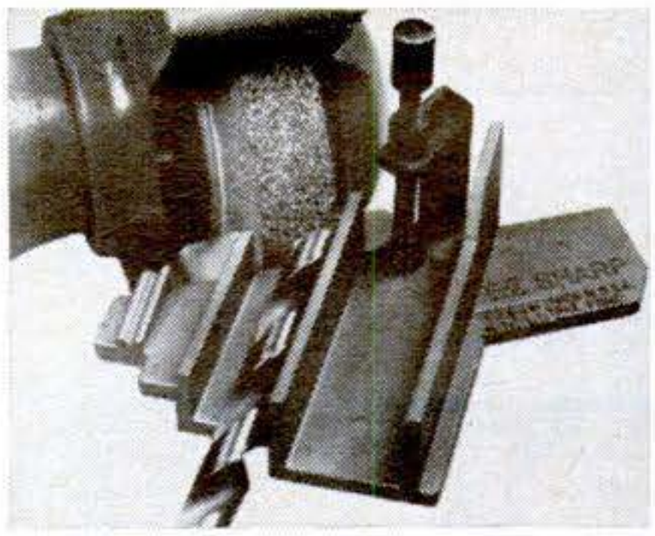

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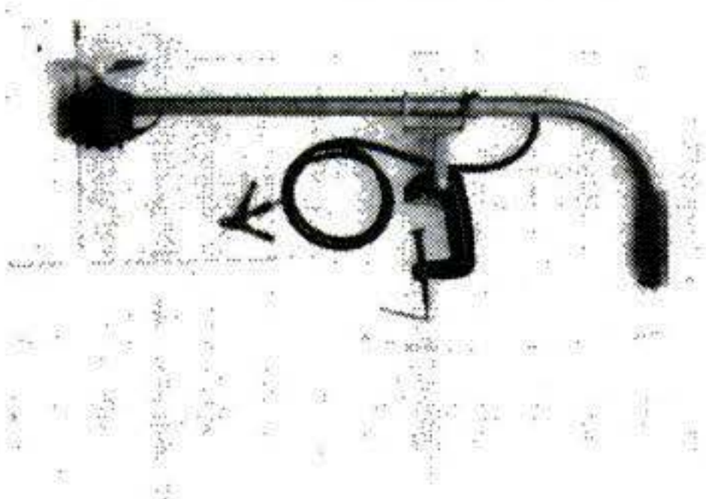

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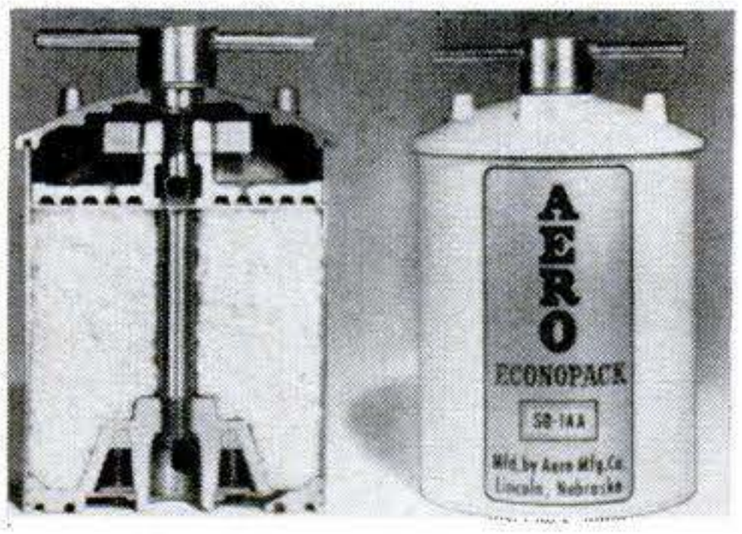

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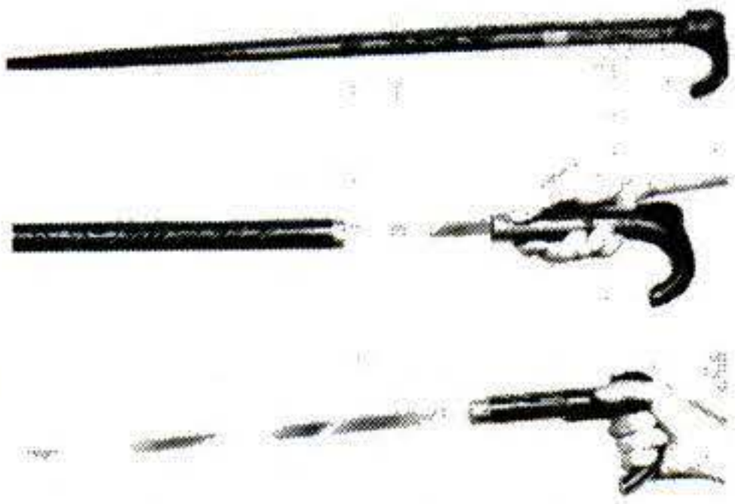

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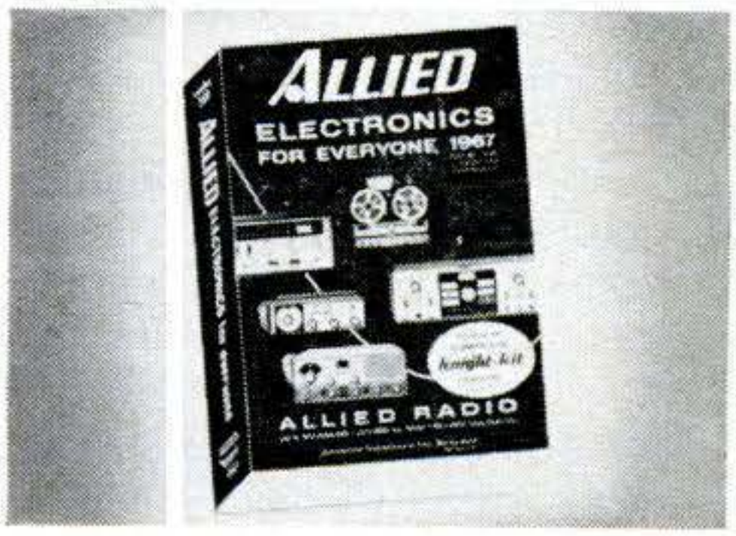

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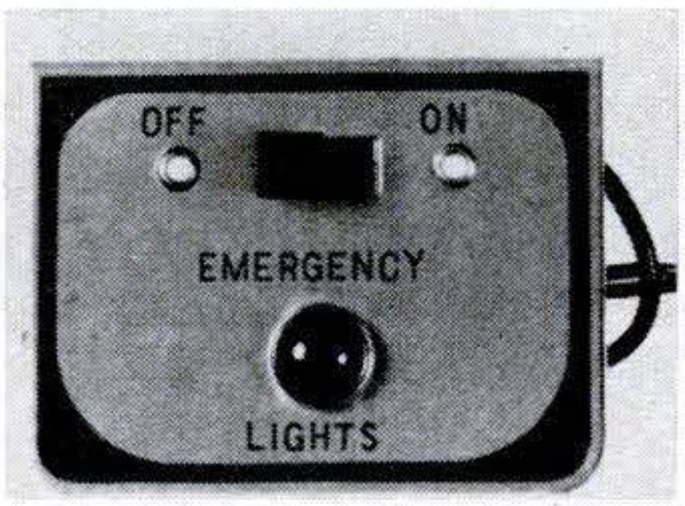

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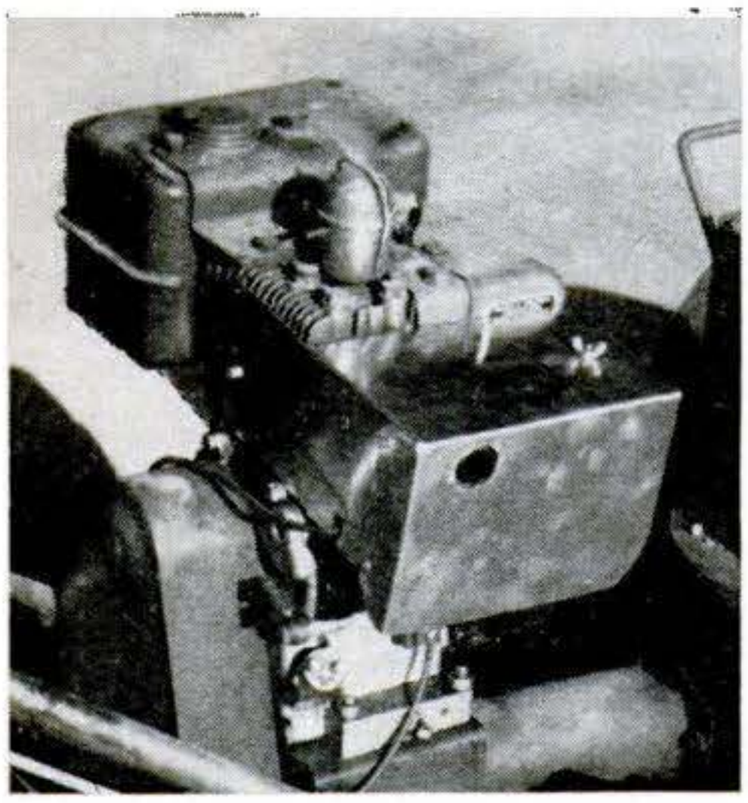
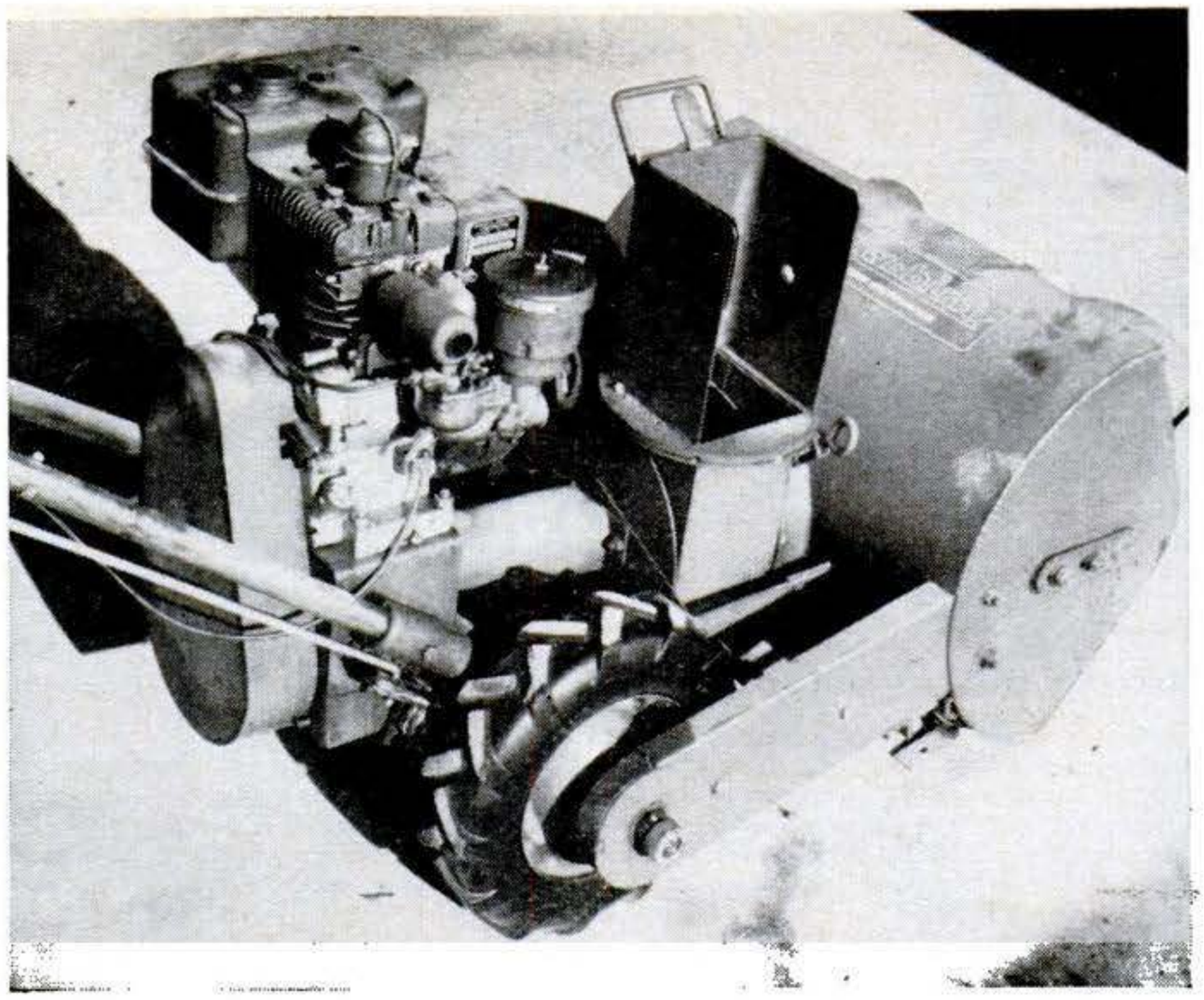




Cover snow-thrower carb for fast starts

On some older snow throwers, the carburetor is entirely or partly exposed to the elements. Installing a protective aluminum cover like the one in the photo above at left is time well spent. Make sure the cover surrounds part of the engine block and muffler to collect and direct some of the heat past the carburetor. Besides improving engine starting, the heat will keep the carburetor linkage clear of the ice that sometimes makes the engine inoperative. The aluminum sheet used to make the cover should be .032″ or more thick. Make a pattern out of cardboard before attempting to cut the metal.

C. H. Hubachek, N. Branford, Conn.

Copper tubing cleans file

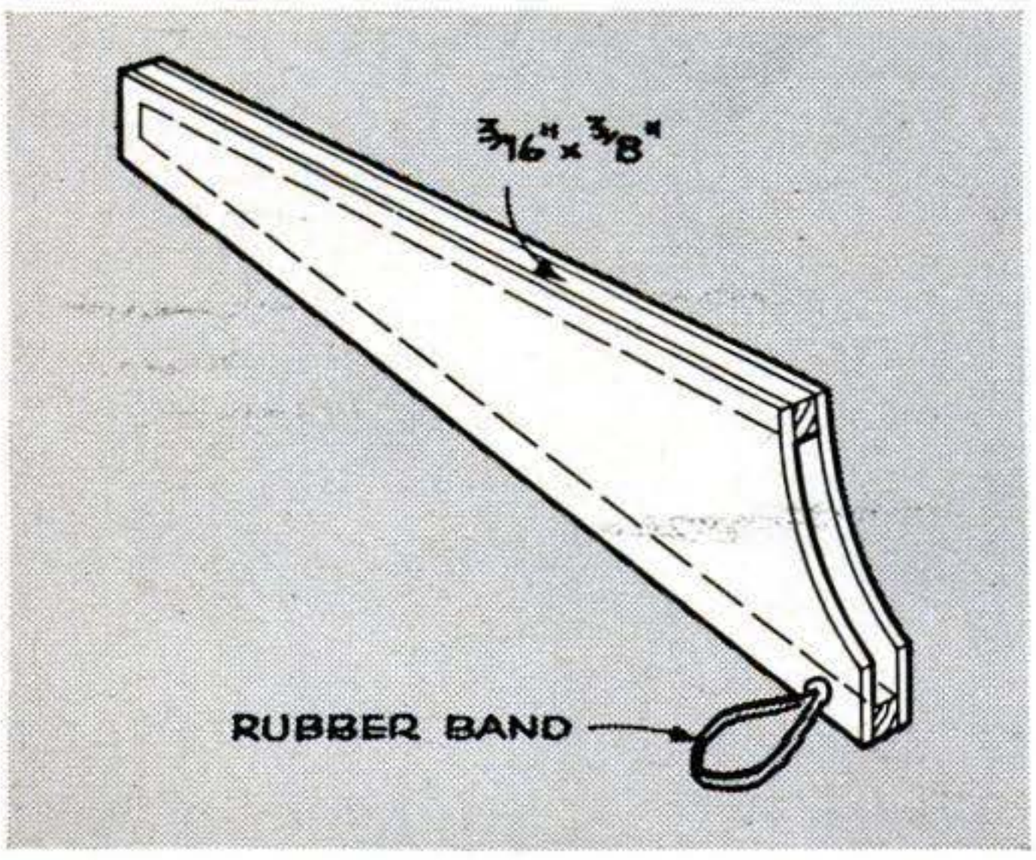
A small piece of any size copper tubing, flattened on one end, can be rubbed into the valleys of a clogged file to clean them out.

H. Wennerstrom, Eau Claire, Wis.

No studs? Try this nail trick

When I needed 10-24 studs 3⅝″ long and had none on hand, I found that 20-penny nails could be cut to the right length for the purpose.

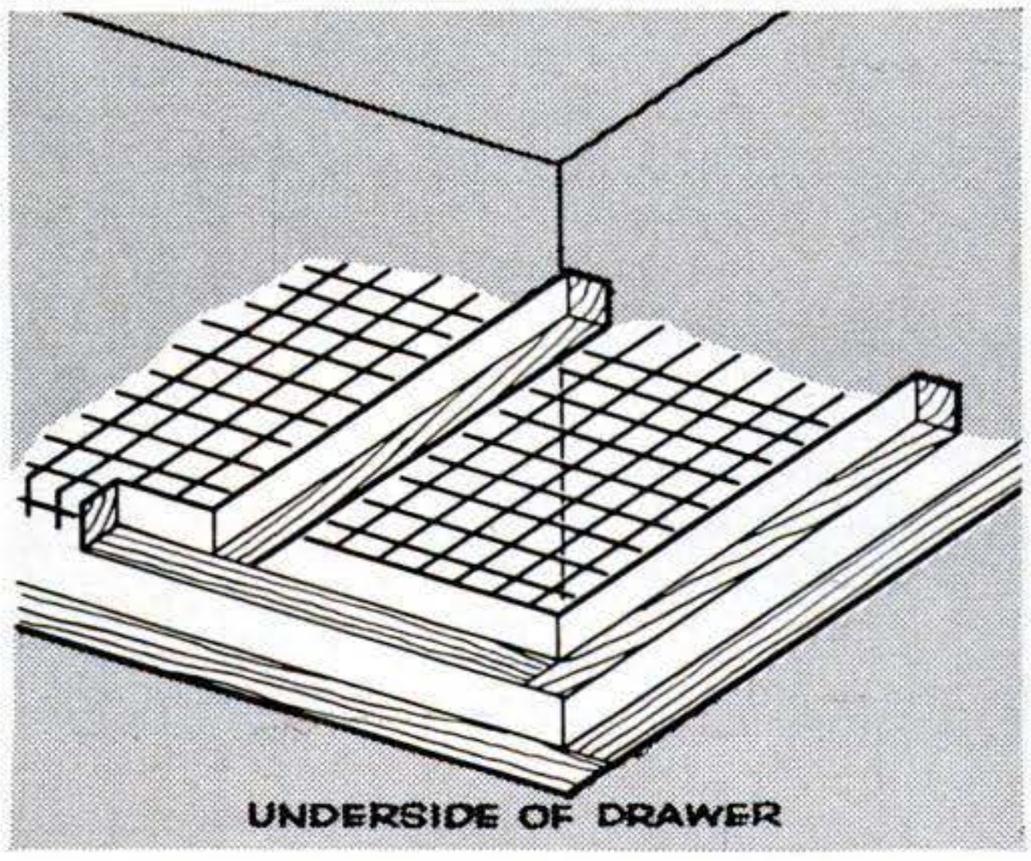
Hermon E. Cotter, Detroit, Mich.



Saw travels safely in simple case

Two sides of ⅛″ hardboard make the handy saw case shown above. Wood strips, 3/16″ by ⅜″, are glued and nailed between. A heavy rubber band from the case slips over the saw handle to keep the saw in place during travel.

C. Rathje, Wyomissing, Pa.



Workbench drawers won't collect dust

Tired of cleaning dust and chips from workbench drawers? A hardware cloth of ¼″ mesh installed as a drawer bottom will hold tools while letting dust and small shavings fall through. Wood strips support the cloth.

Bob Tom, Indiana, Pa.

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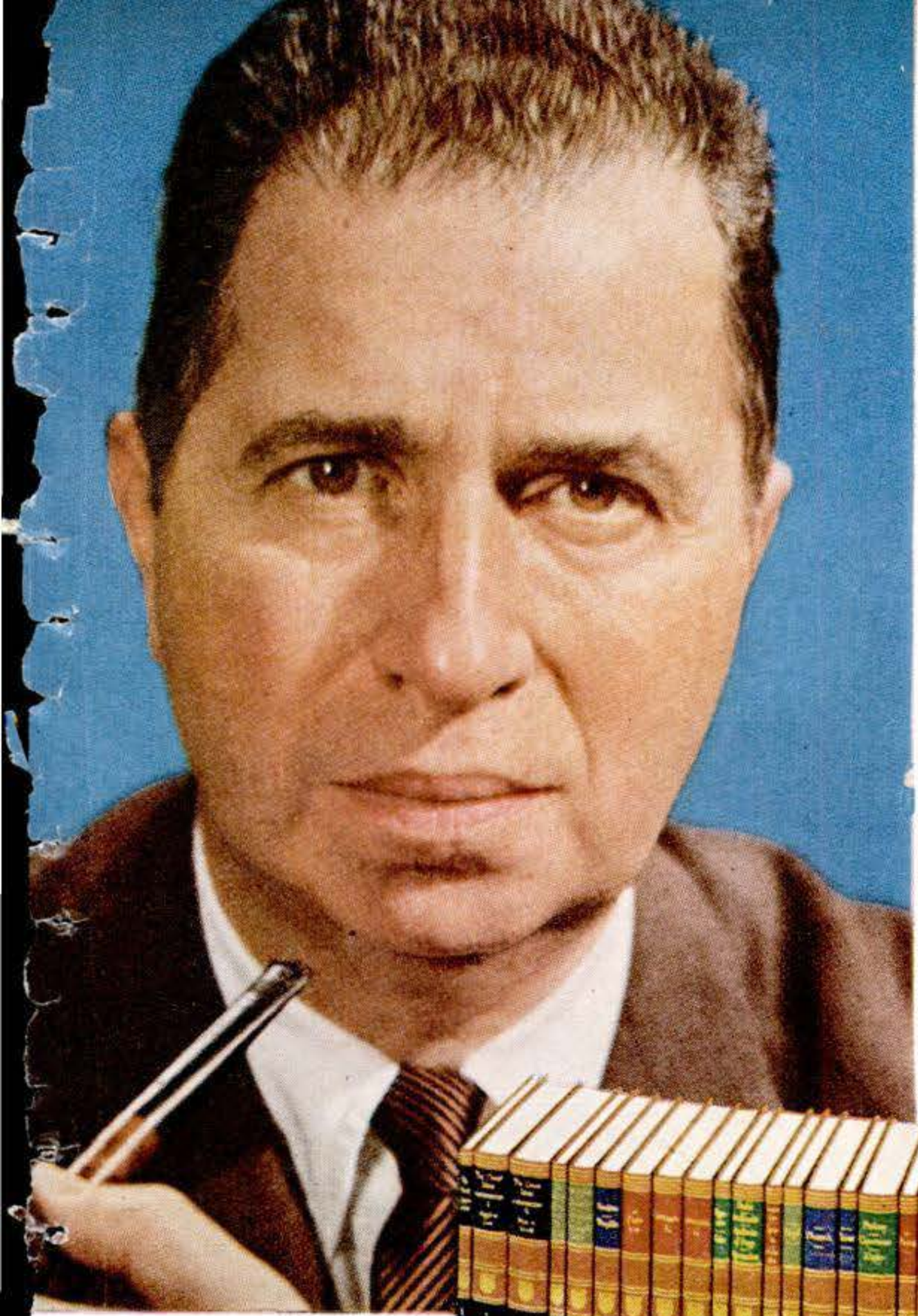


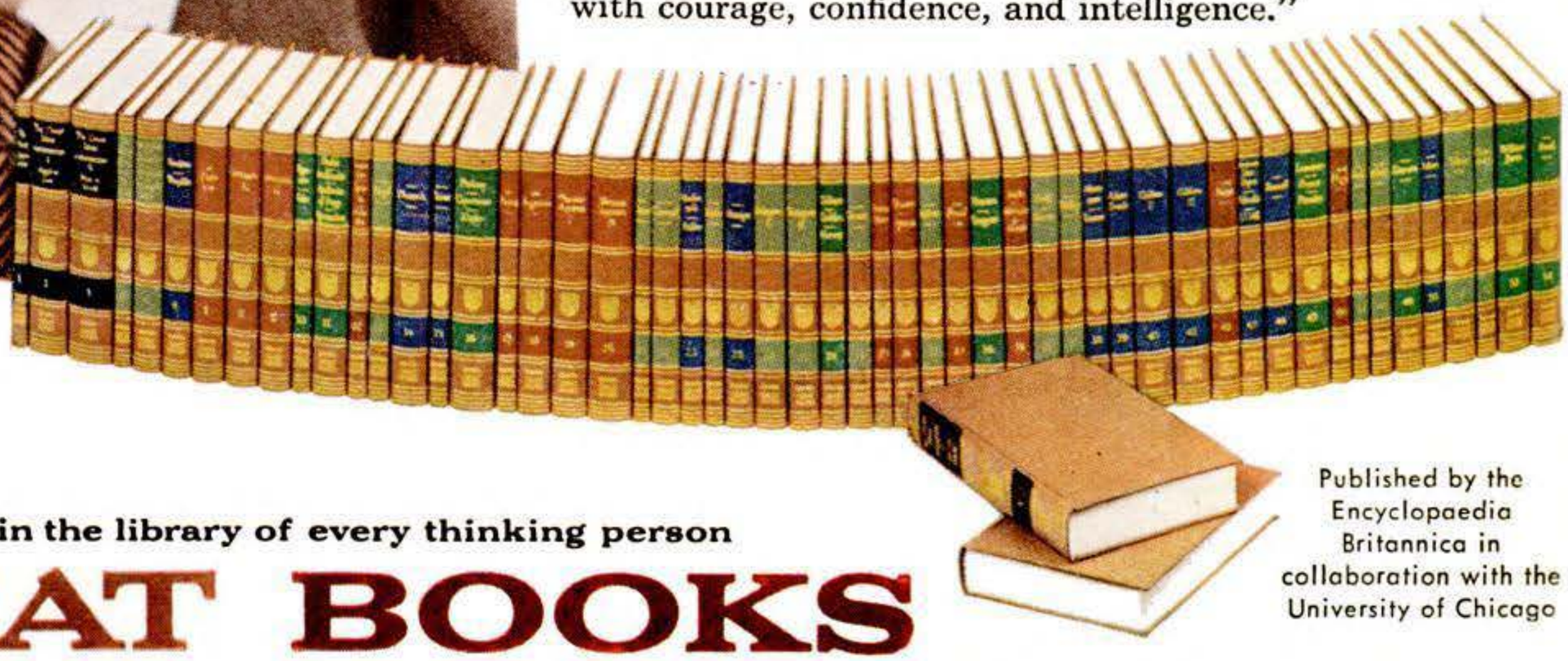
If college education does not make an educated man

A message from **Dr. Mortimer J. Adler**
Director of the Institute for Philosophical Research
Editor of the SYNTOPICON

"The ultimate end of education is not just to learn to be an engineer, a lawyer, a doctor, or a scientist. These are skills—like any others—which help you earn a living and render a useful service to society. But knowledge of any one particular subject is not necessarily evidence of an educated man.

"Education is the sum total of one's experience, and the purpose of higher education is to widen our experience beyond the circumscribed existence of our own daily lives. Most people have only begun their education when they finish school, and after school the steady pressure of a job narrows rather than expands their experience.

"That is why the GREAT BOOKS described below were published—to give every thinking person, no matter what his degree of formal education, the opportunity to become a really educated man. Through GREAT BOOKS you can acquire for yourself the total experience of the whole human race. With that experience, you will then be far better equipped to face life and love it—to meet its challenges and problems with courage, confidence, and intelligence."



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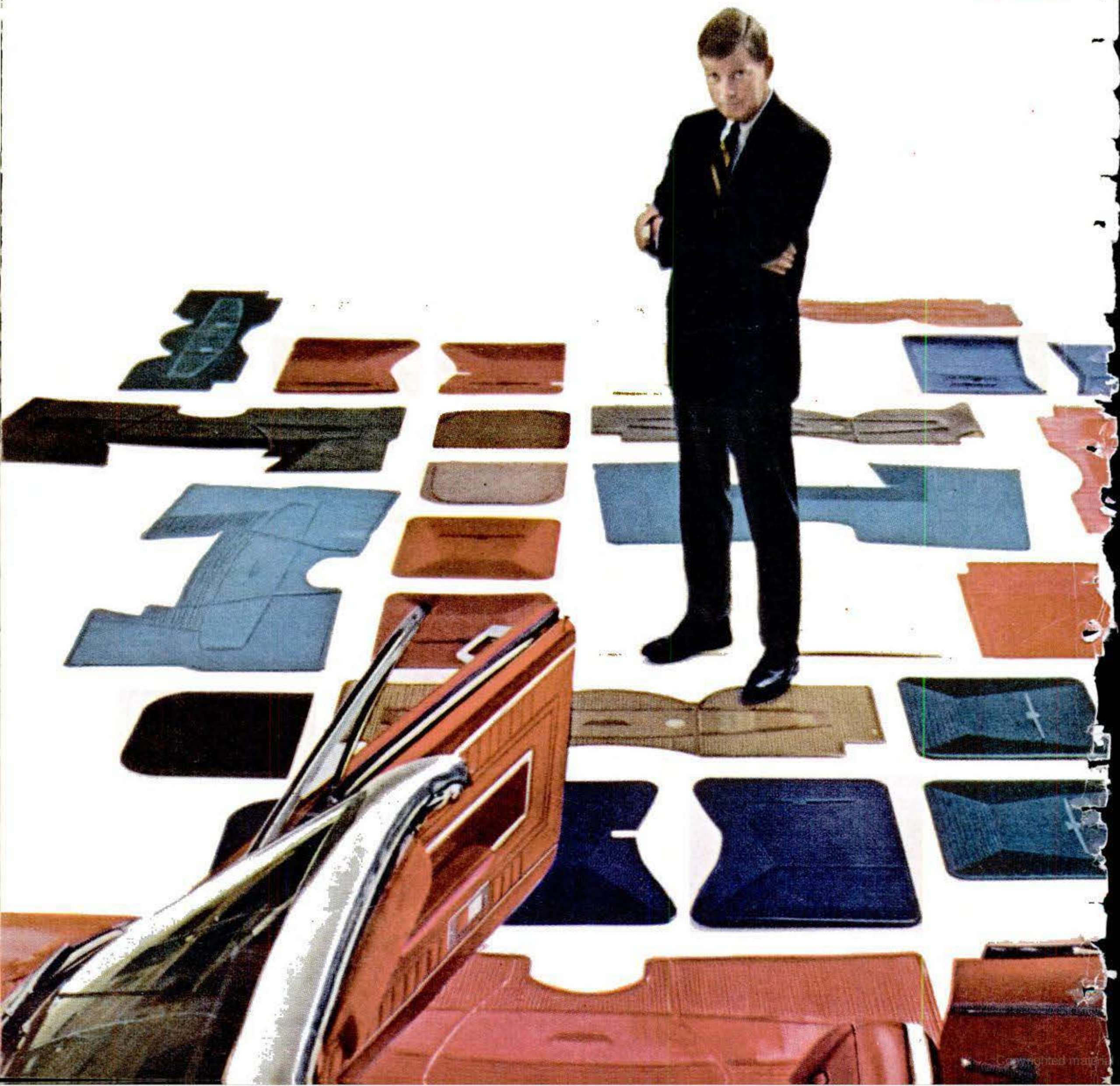

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